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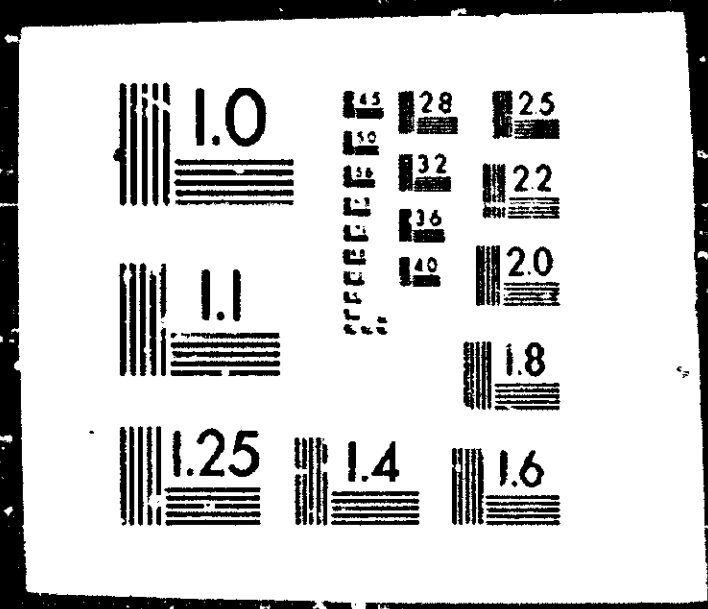

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Safety Effectiveness Evaluation: Federal Highway Administration Non-Interstate Resurfacing, Restoration, and Rehabilitation Program

(U.S.) National Transportation Safety Board
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16. Abstract Beginning in 1976, Federal funds have been available to States for "resurfacing, restoration, and rehabilitation (RRR)" projects on the Federal-aid Highway System. This report analyzes the activities of the Federal Highway Administration (FHWA) to implement a national program for preserving and improving the non-Interstate, Federal-aid Highway System through the use of Federal funds for RRR work. The report reviews the overall nature of the Federal-aid Highway Program; briefly describes the characteristics of the Federal-aid Highway System; and describes the general findings of the "Report of the Secretary of Transportation to the Congress on the State of the Nation's Highways: Conditions and Performance (January 1981)." Finally, the report closely reviews and analyzes the three major rulemaking notices issued by the FHWA on the RRR program since 1976, including the "cost/benefit analysis" published by the FHWA in support of the rulemaking effort.

The Board found that the FHWA has not developed a coherent program for RRR work based on reliable research that would provide a basis to measure the program's safety and durability impacts. The Board concluded that the 5-year rulemaking record is contradictory, unsupported by fact, and seriously misleading. The report is critical of the FHWA's argument that use of lower standards can provide "greater systemwide safety" than higher standards because more miles of roads can be improved. The cost/benefit study does not support that claim. The Board makes several recommendations for RRR program administration improvement.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

SAFETY EFFECTIVENESS EVALUATION

Adopted: September 22, 1981

FEDERAL HIGHWAY ADMINISTRATION NON-INTERSTATE RESURFACING, RESTORATION, AND REHABILITATION PROGRAM

INTRODUCTION

The Independent Safety Board Act of 1974 directs the National Transportation Safety Board to "evaluate, assess the effectiveness, and publish the findings of the Board with respect to the transportation safety consciousness and efficacy in preventing accidents of other Government agencies." In an introductory section to the Act describing the need for an independent Safety Board, Congress indicates that the conduct of this and other Board responsibilities requires "continual review, appraisal, and assessment of the operating practices and regulations" of Federal agencies involved in transportation regulation. In order to fulfill these and other responsibilities, the Board conducts studies and makes recommendations to appropriate agencies.

This study evaluates the activities undertaken by the Federal Highway Administration (FHWA) of the U.S. Department of Transportation (DOT) to implement a national program for preserving and improving the non-Interstate, Federal-aid Highway System through the use of Federal-aid funds for resurfacing, restoration, and rehabilitation (RRR). Although Interstate highways are part of the Federal-aid system, and are eligible for RRR funds, these types of projects are administered through a separate Interstate RRR program and are not evaluated here.

THE FEDERAL-AID HIGHWAY PROGRAM

The Federal-aid Highway Program is a Federal grant-in-aid program through which the States are given financial assistance to construct the Federal-aid Highway System. The Program is financed through the Highway Trust Fund, a collection of revenues from Federal taxes on a variety of highway-related items, such as fuels, tires, and other equipment. In 1979, approximately $8.2 billion in Federal funds were spent by the States on the Federal-aid Highway System. 1/

The program is basically shaped and directed by the Congress. The Congress periodically determines, through legislation, overall program policy, the types of roads the system may include, the kinds of projects which may receive Federal aid, the Federal share payable in those projects, the formulas for determining each State's share of the annual highway appropriations, and the respective duties and responsibilities of the FHWA and the State highway departments in implementing the program.

The FHWA is the "steward" of the program, implementing overall Congressional program policies. Although the design standards to be used on Federal-aid projects have traditionally been developed by the States (through their national organization, the American Association of State Highway and Transportation Officials (AASHTO)) and subsequently adopted by the FHWA, the Federal agency is ultimately responsible for the

1/ FHWA, Highway Statistics 1979, Table FA-3, p. 52.

proper design and construction of the system. The FHWA is charged by law with ensuring that State-proposed projects on the Federal-aid system (using Federal-aid funds) "will adequately meet the existing and probable future traffic needs and conditions in a manner conducive to safety, durability, and economy of maintenance" and that they will be "designed and constructed in accordance with standards best suited to accomplish the foregoing objectives. . . ." 2/ Furthermore, the FHWA is required to "give priority to those projects which incorporate improved standards and features with safety benefits " 3/

The FHWA's administration of the program is carried out primarily through an extensive field organization. Nine Regional Administrators and 50 State-level Division Administrators implement and oversee the day-to-day relationship with the States. Except in a few States which construct Federal-aid projects through a certification process, the Division Administrators are responsible for approving project plans and making at least a final inspection of each Federal-aid project.

The FHWA, as the administrator of this Federal program, is also responsible for providing the Congress with information necessary for developing the policies governing the overall program. Because the program is so large and complex, the Congress must depend, for the most part, on the FHWA for data about the Federal-aid Highway System's condition and needs, and changes needed in the governing policies.

The States, with the approval of the FHWA, determine what projects will be undertaken and perform the actual design and construction. Each State receives a yearly "apportionment" (determined by statutory formula) of the trust fund monies authorized and appropriated by the Congress for the Federal-aid Highway Program. This distribution of funds is categorized to some extent—that is, certain funds are available for projects on the Interstate System, others for the Secondary and Urban Systems, others for safety projects, etc. Non-Interstate RRR funds are not categorized, however; any funds apportioned for construction or reconstruction on the Primary, Secondary, or Urban Systems may be used for RRR projects on these systems. In FY 79, 31 percent of the total non-Interstate, Federal-aid obligations on roadways was for RRR projects; in FY 80, the proportion increased to 37 percent. 4/

The proportion of project costs payable by the Federal funds varies considerably; for example, construction projects on the Interstate System may receive up to 90 percent Federal funding, bridge replacement projects up to 80 percent, Primary, Secondary, and Urban System projects up to 75 percent. The Federal share payable for Federal-aid RRR projects is 75 percent.

The maintenance of the Federal-aid Highway System is, by law, the responsibility of the States. No Federal-aid funds are available for maintenance. Moreover, States must sign a formal agreement at the outset of each Federal-aid project, providing for State maintenance of the project after completion of construction. 5/ Furthermore, the FHWA is required to withhold approval of "further projects of all types in the entire State" if the State fails to "properly maintain" its Federal-aid projects. 6/ The FHWA has not promulgated criteria for describing "proper maintenance" under this provision of the law and has never imposed sanctions on a State for inadequate maintenance.

AASHTO, the State highway departments' national organization, has had a strong influence on the Federal-aid Highway Program in two major ways. Historically, the

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2/ 23 U.S.C. 109(a).
3/ 23 U.S.C. 105(f).
4/ FHWA, Office of Fiscal Services, Table F63.
5/ 23 U.S.C. 110(a).
6/ 23 U.S.C. 116(c).

FHWA has worked very closely with AASHTO in the development of Federal highway policies. The FHWA provides substantial staff support to AASHTO, and mid-level FHWA officials serve as Secretaries to AASHTO committees, participating in AASHTO deliberations as nonvoting members. Importantly, highway design standards have been developed by AASHTO; these subsequently have been adopted by the FHWA for use on Federal-aid projects. This close relationship between AASHTO and the FHWA for development of Federal-aid standards has been somewhat reduced in recent years by the FHWA's gradually increasing use of an informal public rulemaking process. 7/ AASHTO is also influential through its regular appearance at Congressional hearings on highway legislation, in which its testimony is considered representative of the State highway departments as a whole.

THE FEDERAL-AID HIGHWAY SYSTEM

Excluding 40,830 miles of completed Interstate System miles, the Federal-aid Highway System currently comprises 782,763 miles of urban and rural roads. Besides the Interstate, there are three classifications of Federal-aid highways: Federal-aid Primary, Federal-aid Secondary, and Federal-aid Urban. Highways are also classified by the type of "function" they are assumed to provide; this system of categorizing highways is called the "functional classification system" and includes major arterials, minor arterials, major collectors, and minor collectors. The Federal-aid Primary System is made up largely of rural and urban major and minor arterials; the Federal-aid Secondary System is made up (since 1973) of rural major collectors; the Federal-aid Urban System is made up of urban collectors and major and minor arterials that are not part of the Federal-aid Primary System. Minor collectors are not part of the Federal-aid Highway System. Table 1 (page 4) depicts the Federal-aid Highway System mileage by functional classification.

Estimated Condition of the System

Although a number of studies in recent years have analyzed the current and future condition of the nation's highway system, including the Federal-aid Highway System, it is difficult to draw a clear picture. This is true for a number of reasons. First, studies performed by different organizations have reached somewhat different conclusions. Second, different studies have focused on different aspects of "system condition," sometimes emphasizing merely pavement condition, sometimes including geometric configurations and deficiencies. Third, most studies have provided estimates of overall national highway system conditions, including both Federal-aid and non-Federal-aid roads, often without noting that fact and describing its impact on the resulting estimates of conditions and costs. For the purposes of considering alternative approaches to the preservation and upgrading of the Federal-aid system (the roads for which Federal-aid funds are available), these studies can be misleading.

For the purpose of estimating highway conditions (of the Federal-aid system) in this report, the Safety Board has relied primarily on two DOT studies: The Status of the Nation's Highways: Conditions and Performance (January 1981) and 1981 Federal Highway Legislation: Federal Finance Options (September 1980). Both of these papers are marred, for Federal-aid policy development purposes, by the fact that the assumed conditions and cost estimates sometimes include non-Federal-aid mileage, the amount of which is difficult to determine. The 1981 report (the "Secretary's Report") does, however, provide some specific information on the Federal-aid Highway System alone.

7/ In 1978, a U.S. Court of Appeals ruling (U.S. Court of Appeals (D.C. Cir.) 580 F.2d (1978)) limited the AASHTO/FHWA interaction to that permitted by the Federal Advisory Committee Act. Nevertheless, FHWA officials continue to serve as Secretaries to AASHTO committees and participate in unpublicized AASHTO meetings.

Table 1.--Federal-Aid Highway System mileage by functional classification.

Functional Classification	Federal-Aid System (Non-Interstate)			
	Primary System	Secondary System	Urban System	TOTAL
Rural				
Major Arterial	82,111	—	—	82,111
Minor Arterial	148,410	—	—	148,410
Major Collector	—	401,477	—	401,477
Minor Collector	—	—	—	—
Total Rural	230,521	401,477	—	631,998
Urban				
Major Arterial	27,383	—	21,310	48,693
Minor Arterial	1,237	—	54,918	56,155
Collector	—	—	45,917	45,917
Total Urban	28,620	—	122,145	150,765
Total Federal Aid (Non-Interstate)				782,763

Derived from Federal Highway Administration, Highway Statistics, 1979, Table M-21A (as of September 1980) p. 107.

Pavement Condition.—Generally, these two DOT studies characterize the current (1978) pavement condition of the overall highway system as "acceptable." The Secretary's Report concludes that:

> At the close of 1978, the majority of pavement on all functional systems in both urban and rural areas was in acceptable condition (either fair or good).
>
> * * * * * *
>
> ...[I]mprovements have tended to offset the deterioration in the physical plant so that, on the national level, systemwide travel conditions appear to have remained fairly stable throughout the 1970's.... While some pavement deterioration and increased travel per lane-mile took place during the study period [1970-1978], there were no significant increases in physical deficiencies. 8/

In particular, the 1981 Finance Options paper found that the Federal-aid Primary System is "in good [pavement] condition overall." 9/

Pavement conditions on the Federal-aid Secondary System are not so good, according to the Secretary's Report:

8/ Pp. 79 and 114.
9/ P. 1.

> Of all rural highways eligible for Federal-aid highway funds, the Federal-aid Secondary System is in the poorest condition. . . . Fourteen percent of the secondary mileage is still unpaved. Of the remainder, 8 percent . . . needs immediate resurfacing. Only 28 percent of the existing paved roads can be classified as having a good . . . surface. 10/

Currently, "7 percent of the [Federal-aid Urban] system pavement needs immediate replacement. . . . About 50 percent of all Urban System pavement is in fair condition, [and] about 43 percent is in good or nearly new condition." 11/

Table 2 shows the Secretary's Report rating of the overall 1975 and 1978 pavement condition of the rural and urban functional classifications (non-Interstate arterial and collector roads) that were analyzed. (Although virtually all of the rural arterials analyzed in the Secretary's Report seem to be Federal-aid Primary roads, it is unclear what percentage of the other rural and urban functional classification roads analyzed were Federal-aid and what percentage were non-Federal-aid.)

Table 2.—U.S. DOT rating of pavement condition on non-Interstate highways, 1975 and 1978.

Functional Classification	1975			1978		
	Good %	Fair %	Poor %	Good %	Fair %	Poor %
Arterials, rural (99% Federal-aid)	47	46	7	42	52	6
Arterials, urban (% Federal-aid unknown)	48	46	6	41	53	6
Collectors, rural (% Federal-aid unknown)	30	60	10	25	66	9
Collectors, urban (% Federal-aid unknown)	36	55	9	34	59	8

Derived from The Status of the Nation's Highways: Conditions and Performance (U.S. DOT, January 1981). Fig. 3-8, page 74 and Fig. 3-9, page 75.

As to the future pavement conditions, the Secretary's Report estimates that:

> —Over 90 percent of the existing Federal-aid Primary mileage in rural areas will require at least resurfacing during the 1980-1985 period. 12/

10/ Pp. 171-172.
11/ P. 174.
12/ P. 169.

> --In urban areas, the Federal-aid Primary connecting highways will add an additional 24,000 miles of roads requiring either resurfacing or rehabilitation of the pavement. 13/
>
> --Only 5 percent of the existing Federal-aid Secondary System will not need resurfacing or reconstruction in the next 15 years. 14/
>
> --Over 95 percent of the Federal-aid Urban System will require repaving or pavement rehabilitation by 1995. 15/

Geometric Condition.--The Secretary's Report also discusses, in broad terms, the geometric conditions of the Federal-aid Highway System. Although the report concludes that the current pavement condition of the Primary System is "good," the geometric design of much of this mileage was found to be seriously deficient, even with current travel loads, and likely to present even greater hazards in the future. The Secretary's Report says:

> In 1978, 13 percent of the rural [Federal-aid Primary] mileage had lane widths of 10 feet or less. Twelve percent of the mileage had earth shoulders of less than 5 feet, and 6 percent of the mileage still had horizontal or vertical alignment deficiencies which create unsafe conditions. In 1978, over 15 percent of the total travel on the system was exposed to one or a combination of these unsafe conditions. 16/

Only 43 percent of the Primary System had surfaced shoulders. 17/

Although "travel on the Primary System during the 80's is expected to grow at a slower rate than during the 1970's, . . . approximately 20 percent more travel will occur on this System at the end of the decade." 18/ This increased travel load "will also create greater exposure to safety hazards on those existing sections which presently have poor geometric design. Nationally, almost 85 percent of all Primary mileage either has or will develop one or more [geometric] deficiencies by 1995." 19/

As to the Federal-aid Secondary System, the Secretary's Report found:

> Design deficiencies related to safe travel remain on a sizable percentage of the secondary system. Sixteen percent of the mileage still has travel lanes 9 feet wide or less . . . [and] over 10 percent has multiple deficiencies relating to both roadway and geometric design. By this measure, over 39,000 miles of the system are presently unsafe for the volume of traffic they serve. 20/

Only 16 percent of the Secondary System has surfaced shoulders. 21/

13/ P. 169.
14/ P. 172.
15/ P. 174.
16/ P. 169.
17/ Fig. 3-28, p. 102.
18/ 1981 Finance Options, p. 10.
19/ Ibid., p. 11.
20/ P. 172.
21/ Fig. 3-28, p. 102.

The Secretary's Report estimates that by 1995 the Secondary System will be carrying 30 percent more travel than in 1978, and notes:

> In addition to the current deficiencies, future travel will create extensive problems on many sections which are currently adequately designed. By 1995, approximately 90 percent of all secondary system mileage will incur one or more deficiencies related to pavement, geometrics, roadway cross-section or operating performance. 22/

The Secretary's Report provides little information on the geometric condition of the Federal-aid Urban System, other than to say that about 18 percent of its bridges have "some deficiency"—mostly "deck geometry" (i.e., they are too narrow). 23/

Estimated Cost to Maintain the System

The Secretary's Report provides overall estimates of the anticipated costs to maintain 1978 Federal-aid Highway System conditions, but does not delineate how much of those costs would be for pavement maintenance versus other efforts to maintain 1978 performance levels, such as geometric or traffic operations improvements. The overall estimates are as follows:

Primary System

> To offset the deterioration of physical and operating conditions and to keep the overall performance . . . at a 1978 level, will require a total 15-year investment varying from $49.6 billion to $62.9 billion [1980 dollars], depending on the rate of growth of [travel]. Assuming that the State and local capital investment on the system remains at the same relative level as it is in 1980, the Federal share in the overall cost would range between $23.8 billion and $30.2 billion. 24/

Secondary System

> The estimated cost of offsetting the effects of future [travel growth] on the system varies between $55.6 billion and $59.3 billion over the next 15 years. This level of investment would provide sufficient funds to maintain present levels of safety, condition and service on the existing secondary system. . . . The Federal share of this is between $16.7 and $17.8 billion. . . . 25/

Urban System

> Improvement costs on the Federal-aid Urban System through 1995 are estimated to range between $39.5 and $40.3 billion. . . . [T]his level of funding will both offset future physical deterioration and eliminate those [pavement] deficiencies that currently exist. . . . [T]he Federal share of capital costs would be $16 billion. . . . 26/

22/ P. 172.
23/ P. 174.
24/ P. 170.
25/ Pp. 172-173.
26/ Pp. 175-176.

BACKGROUND OF THE RRR PROGRAM

In recent years there has been increasing concern about the current and future condition of the nation's highway system, including the Federal-aid Highway System. Although estimates of highway conditions vary considerably, most observers seem to agree that a substantial amount of mileage has deteriorated from a "good" to a "fair" condition and that the rate of deterioration will probably increase rapidly during the next 10 to 15 years. Some observers have noted that travel is likely to increase substantially during the same period, and that the geometric design deficiencies that are responsible for many highway deaths each year will pose even greater hazards under heavier travel loads.

At the same time, the costs of highway projects have escalated even faster than the rate of overall national inflation. Throughout the 1970's, highway construction costs increased at an average annual rate of 10.5 percent. Since 1973, the average annual rate of increase has been 12.5 percent--a pace that doubles costs every 6 years. 27/ Furthermore, tax revenues to pay for highway projects have decreased because of reduced levels of automobile travel during the mid-1970's, a more fuel-efficient automobile fleet, and the cents-per-gallon nature of the taxes as distinguished from a sale price percentage. As highway costs rose and highway revenues remained static or even decreased, some States began deferring maintenance. A 1981 report by the U.S. General Accounting Office documents the rapidly increasing backlog in many States of both routine preventive maintenance (pothole patching, crack sealing, etc.) and such projects as pavement resurfacing. 28/

After hearing evidence of these general conditions, the Congress authorized in the 1976 Highway Act the use of Federal-aid construction funds for "resurfacing, restoration, and rehabilitation" projects on the Federal-aid Highway System. Beginning in 1977, the FHWA has published a series of proposals for implementing this authorization. During this period, States have been able to use the Federal-aid funds available for RRR projects under the normal procedures for obligation of Federal-aid construction funds. However, both the FHWA and the States have wanted to establish separate, lower design standards for RRR projects. The purpose of the FHWA proposals for implementing the RRR authorization has been to establish such separate standards.

The Safety Board has been concerned about the RRR program 29/ since 1977 and has commented on each of the FHWA proposals. The Board believes that the way in which the RRR funds are used will have a major impact on the short- and long-term safety and durability of the Federal-aid Highway System. The reasons for the Board's safety concerns about the RRR program are outlined below.

RRR and Safety

In the past, the Federal-aid Highway Program has consisted largely of new construction and reconstruction projects. Highway design standards have improved over the years, and Federal-aid new construction and reconstruction projects are required to

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27/ 1981 Finance Options, p. 57.
28/ U.S. General Accounting Office, Deteriorating Highways and Lagging Revenues: A Need to Reassess the Federal Highway Program, CED-81-42, March 5, 1981.
29/ Because RRR funds are not provided separately from the overall Federal-aid construction funds apportioned each year to the States, it is somewhat misleading to refer to it as a "program," as though it were separate. The term is used in this report for the sake of simplicity.

be built to the most recent standards. Thus, the predominance of new construction/reconstruction in the program has resulted in a steady increase in the level of the designed-in safety of the Federal-aid Highway System. The continuous renewal and upgrading of parts of the system, and additions of new segments built to higher standards, have allowed the system to absorb more traffic without a commensurate rise in the numbers of deaths and injuries. The Interstate System, usually built to the highest standards, is the most striking example of this, but it has been true of all the Federal-aid Highway System roads.

These trends in the Federal-aid Highway Program are now changing. The proportion of Federal-aid construction/reconstruction projects is declining, while the proportion of RRR-type projects is increasing. The level of designed-in safety provided through RRR projects, particularly on the thousands of miles of currently substandard primary, secondary, and urban roads, will determine to a large extent whether or not the numbers of deaths and injuries on these roads begin to rise again. The design standards used on these projects is thus a matter of extreme importance to safety. Further, just as there is a strong Federal interest involved in the safety design of these roads when they are constructed and reconstructed, there is also a strong Federal interest in the level of safety provided through federally-aided RRR projects on them.

This concern was expressed in a 1979 study by the FHWA's Office of Highway Safety of the potential impact of RRR projects on safety:

> [New] highways have been constructed based on constantly improving design standards which result in improved safety. These efforts have contributed to the consistent downward trend in accident and fatality rates. Now, however, reduced standards are proposed which would not require the correction of known substandard hazardous features. In addition, highway construction and reconstruction is declining in favor of simple resurfacing projects that have short life spans. It is possible to speculate that these sharply reduced contributions to the safety effort could markedly influence nationwide accident rates and could even bring about the first consistent upward trend in accident and fatality rates in our history. 30/

These concerns are heightened by the fact that the sheer amount of vehicle travel increases steadily each year, and that the proportions of heavy trucks and small cars, light vans, and motorcycles have increased dramatically in the past 10 years and will soon come to dominate the vehicle mix. The upper and lower ranges of vehicle sizes and weights are growing further apart. Few of our roads were fully designed for this range of vehicles. Any consideration of the impact of road design on safety must also include consideration of the current and future vehicle sizes and safety design. All this means that the job of reducing or even holding steady the numbers of Americans killed or hurt during highway travel is going to become more difficult and will probably be influenced more by the level of safety provided by the road itself. The scope and nature of the RRR program will have a large, possibly decisive, effect on the outcome.

Because a simple resurfacing project costs considerably less than projects involving more substantial roadway improvements, there is a strong incentive for States to use RRR funds primarily for resurfacing-only projects. Because there is no upper limit on the proportion of Federal-aid construction funds that may be used for RRR projects, it is possible that, without guidance, much of the Federal-aid Highway Program may gradually

30/ FHWA, Office of Highway Safety, Safety Impact of Resurfacing Rural Roads, no date, p. 2 (apparently prepared around June 1979).

become merely a Federal-aid resurfacing program. The Safety Board is concerned about two safety implications of this fact. First, resurfacing-only projects do not reduce the hazards on existing substandard roads, such as narrow lanes, narrow or no shoulders, sharp curves, dangerously short sight distances and passing distances, narrow bridge approaches, substandard barriers, and the proximity of thousands of roadside objects that account for about 17,000 deaths each year (one-third of the annual highway fatalities). Even with current travel loads, these roadway and roadside deficiencies cause thousands of highway deaths and injuries each year. With the anticipated increases in travel loads, these hazards will become even more severe. Furthermore, some experts believe that resurfacing-only projects actually increase the hazards of a substandard road, since operating speeds may increase after the surface is repaved. Additionally, with no requirement that repaving projects improve the skid resistance of the road (in many cases such projects have reduced the skid resistance), 31/ resurfaced-only roads may become even more hazardous 32/

As noted in the FHWA Office of Highway Safety study, resurfacing-only projects have "short life spans." Typically, construction or reconstruction projects have a design life of about 20 years; 33/ resurfacing typically lasts 5 to 8 years. Thus, resurfacing must be repeated several times during a 20-year period in order to be as serviceable at the end of the period, while construction, reconstruction, or substantial upgrading projects normally need be performed only once in a 20-year period. Repeated resurfacings consume funds that could be used for improvements with a longer design life and a positive impact on safety.

Finally, the level of safety provided through RRR projects becomes even more critical in light of the current FHWA legislative proposal for modifying the Federal-aid Highway Program. In the past, the FHWA has sometimes responded to expressed concerns about the lack of safety criteria in the RRR program by saying that the RRR program is not intended for safety improvements and that there are specific Federal-aid funds available for safety projects. 34/ However, the current FHWA legislative proposal for the 1982-1986 Federal-aid Highway Program would eliminate safety improvement funds as of October 1, 1981. If no safety improvement funds are available, and RRR projects increasingly dominate the Federal-aid Highway Program, the potential safety impact of these projects becomes even more important.

31/ For example, a recent study by the Midwest Research Institute (MRI) for the FHWA, Effectiveness of Alternative Skid Reduction Measures, November 1978, found that about half the resurfacing projects studied resulted in lower skid resistance.

32/ The MRI study found that "recent research suggests that skidding accidents are increasing rapidly and are reaching proportions that can no longer be ignored. One researcher has indicated that skidding accidents account for more than one third of all vehicle accidents in some geographical areas."

33/ "Design life" refers to the period of time a project is providing intended performance, with only routine maintenance necessary (i.e., doesn't require major maintenance such as resurfacing). The designer's decisions about the geometrics and quality of construction are made on the basis of the intended design life. Of course, actual project life may vary somewhat from the intended design life due to weather and unanticipated changes in such factors as level of maintenance and volume of traffic, particularly heavy trucks.

34/ Regular Federal-aid construction funds may also be used for safety projects. However, because of State reluctance to use these funds for safety, Congress began, in 1973, to authorize specific funds for such projects.

The Safety Board believes that the Federal-aid Highway Program is quickly approaching a critical decision point, both for safety and financial viability (which directly affects safety). As the Secretary's Report stated:

> The reality of declining revenues will accelerate the trend toward preserving what we have and, in so doing, may sacrifice the goal of raising overall system standards. One group in the highway industry calls for greater flexibility in the use of Federal funds when dealing with lower cost or [RRR] improvements, . . . allowing States to stretch funds and provide more miles of improvements. On the other side of the argument, providing such flexibility demands that less stringent standards be accepted, which may potentially result in safety impairment. The resolution of this dilemma will command policymaker's attention throughout the 1980's. 35/

The Secretary's Report, however, seems to assume that the decision has already been made to leave such questions entirely up to the individual States and that policymakers can only stand by and wait for the results of whatever actions the States may take during the next 10 to 15 years. As the Secretary stated:

> It will be necessary to monitor these trends in coming years to accurately determine what is taking place and to what extent. If States are opting to apply less stringent standards or lower type improvements, such as simple resurfacing instead of reconstruction, the results could show up in the future as pavement and structural deterioration rates that exceed those that would normally be expected and the financial burden of remedying the excessive deterioration could prove troublesome to budgets that already show signs of strain. If, on the other hand, highway physical and operating performance measures remain stable over time, this would indicate that the States are building to adequate standards while eliminating project amenities that add costs without improving operating characteristics. 36/

The Safety Board does not believe that we can afford to invest billions of Federal dollars in the Federal-aid Highway System without first deciding the underlying purpose and goals of the Federal-aid Highway Program and crafting policies and procedures to guide the overall program toward those goals. There is a national interest in having a system of safe, durable, and economical highways. Congress created the Federal-aid funding program because it recognized the national benefits that flow from the basic interconnected network of roads that now make up the Primary, Secondary, and Urban Systems. Because these roads serve the interests of everyone, not merely the people of each of the States who build and maintain them, there is a national interest in the policies and programming priorities that determine the levels of safety and durability of the Federal-aid Highway System.

This Safety Board report has been prepared because we believe policymakers must not merely stand by and "wait for the results" of an unguided RRR program but must carefully consider the likely safety and durability impacts of the alternatives available and make decisions among them before proceeding.

35/ P. 4.
36/ P. 23.

EFFORTS TO IMPLEMENT RRR IN THE LAW

Legislative History of RRR

The 1976 amendment of 23 U.S.C. 101(a) to authorize Federal-aid RRR projects reflects the results of a Senate and House conference to resolve differences between the highway bills of the respective houses of Congress. The House bill (H.R. 8235) added the term "resurfacing" to the definition of the word "construction" and the report accompanying the bill described the intention of this amendment:

> ["Resurfacing" would] permit maximum flexibility in the use of Federal funds. . . . The addition of the word "resurfacing" will make clear that Federal-aid funds may be used to restore existing roadway pavements to a smooth, safe, usable condition even though further reconstruction is not feasible. . . . The definition, as amended, coupled with the Secretary's existing authority on standards, would permit Federal funding of such projects as: resurfacing or widening and resurfacing, of existing rural and urban pavements with or without revision of horizontal or vertical alinement or other geometric features. . . . This change . . . evidences no intent to fund normal periodic maintenance activities, which remain a State responsibility. 37/

The report does not describe what is considered "normal periodic maintenance activities."

The Senate bill (S. 2711) added the words "restoration and rehabilitation" to the definition of the word "construction" and the Senate's accompanying report discussed this amendment:

> The words "rehabilitation and restoration" make clear that Federal-aid funds may be used for improvements on existing highways to restore them to their original safe, usable condition. . . . [The report described briefly several types of pavement work that would be eligible, and then continued. . .] It also includes the modification of highway elements on existing or restored roadways to provide for the function or level of service needed to satisfy current and future requirements. If traffic volume has increased over original specifications, physical form may not provide for the service level intended by the original design. Rehabilitation might include added pavement courses of traffic lanes to serve current needs. Similarly, added elements may be necessary to incorporate design or safety standards adopted since construction of the original pavement. 38/

When the two bills went to conference, the House bill's addition of "resurfacing" and the Senate bill's addition of "rehabilitation and restoration" were all added to the definition of "construction." However, the report accompanying the resulting compromise 39/ only discusses the addition of the word "resurfacing," using the language of House Report 94-716 quoted above. The Conference Report also repeats the earlier House committee report statement that the addition of these words "evidences no

37/ H. Rep. 94-716, p. 5; emphasis added.
38/ S. Rep. 94-485, p. 8; emphasis added.
39/ H. Rep. 1017.

intent to fund normal periodic maintenance activities which remain a State responsibility." Again, there is no indication of what is intended to be covered by this disclaimer.

FHWA Implementation of the RRR Amendment

The new highway bill was enacted by Congress on May 5. 1976. On June 28, 1976, the FHWA issued a formal Notice to its field personnel "to provide guidance for RRR projects under the provisions of the Federal-aid Highway Act of 1976 until such time as the formal instructions are issued." 40/ Four terms are described in this Notice:

> Maintenance. As defined in Section 101 of Title 23 [U.S.C.]--"The preservation of the entire roadway, including surface, shoulders, roadsides, structures, and such traffic-control devices as are necessary for its safe and efficient utilization."
>
> Resurfacing. The placement of additional pavement layers . . . over the existing (or restored or rehabilitated) roadway or bridge deck surface to provide additional strength or to improve serviceability for a substantial time period.
>
> Restoration and Rehabilitation. Work required to return the existing structure (roadway pavement or bridge deck) to a suitable condition for placement of an additional stage of construction (bridge deck protective system or resurfacing) or otherwise to perform satisfactorily for a substantial time period. 41/

There is no discussion in the Notice, under the terms "restoration and rehabilitation" of the concept of geometric modifications for safety which the Senate report (the source of the terms) had discussed.

Under a section called "Project Guidelines," the FHWA Notice further discussed what the agency means by the terms "resurfacing, restoration and rehabilitation:"

> (1) Restoration may include replacement of malfunctioning joints, repair of spalled joints, substantial pavement undersealing when essential for stabilizing for resurfacing, grinding/grooving faulted rigid pavements to restore smoothness (where adequate structural thickness remains), adding underdrains and removal and replacement of contaminated or deteriorated materials.
>
> (2) Rehabilitation may include reworking or strengthening of bases or subbases, recycling or reworking existing materials to improve their structural integrity, adding underdrains, or improving shoulders.
>
> (3) Resurfacing consists of adding layer(s) of surface to provide additional structure or improved serviceability.

Again, there is no discussion of the geometric safety improvements that may be necessary under "restoration and rehabilitation," as described by the Senate report.

40/ FHWA Notice N 5040.19.
41/ Emphasis added.

Introduction of Three Alternctives.--On August 25, 1977, (42 F.R. 42876) the FHWA published an Advance Notice of Proposed Rulemaking (ANPRM) (Docket 77-4) to solicit suggestions and comments on establishing geometric design standards for RRR projects. The proposal noted that the Secretary is prohibited by law from approving projects that are not "conducive to safety, durability, and economy of maintenance." It said that "good conclusive data is just not available on the safety sensitivity of individual or interacting geometric design elements" and that "each State is working from a different base." Therefore, the ANPRM said, "The establishment of national standards is difficult in light of the lack of extensive definitive data on the sensitivity of design criteria in regard to safety, and the vast differences between existing State highway systems and other local conditions."

The ANPRM proposed three alternatives for implementation of the RRR authorization. The first alternative would have required that RRR projects be processed as normal construction or reconstruction projects. The design standards would follow the provisions of 23 CFR Part 625 (Design Standards for Highways), although design exceptions would be permitted on individual projects with the agreement of the FHWA Division Administrator in each State.

The second alternative would have permitted Federal-aid RRR project design to be governed by the unique, and lower, design standards developed by AASHTO for use on non-Federal-aid RRR projects. The FHWA would incorporate by reference into 23 CFR Part 625 AASHTO's new publication, Geometric Design Guide for RRR of Highways and Streets. These standards would then have been applicable to all RRR projects except those on the Interstate System.

The third alternative would have permitted each State, in consultation with its FHWA Division Administrator, to develop individual State RRR criteria, using the AASHTO guide and other Part 625 standards and policies as a basis.

Comments on these alternatives were submitted by 204 organizations, the majority being State and local departments of highways. Fifty-one percent of the commenters favored Alternative 2, adoption of the AASHTO guide for use on Federal-aid RRR projects. Of the 44 State highway authorities commenting, 98 percent favored adoption of the AASHTO guide. Alternative 3, development of individual State criteria, was supported by 3 percent of the submissions.

Safety Board staff reviewed the States' comments on this proposal and found that the States supported Alternative 2 primarily on the basis that they believed it would provide uniform nationwide guidance, flexible enough to meet individual State needs. There was also a consensus among State comments that adoption of the AASHTO guide would aid in defending tort litigation. Finally, some States felt that development of individual State criteria (alternative 3) would be burdensome and could cause wide variation in RRR projects and inconsistencies in the FHWA project approval process.

The Safety Board opposed the adoption of either Alternative 2 or 3 on the grounds that both would permit the use of the AASHTO guide on Federal-aid RRR projects. The Board's comments discussed several specific areas in which the AASHTO guide provides substantially lower standards than are currently permitted on Federal-aid projects and noted the contradictions between the AASHTO language that is used to justify the higher standards in current AASHTO new construction standards and the lowered standards set forth in the AASHTO guide. For example, the Board found it "difficult to reconcile the lowering of safety standards in the [AASHTO guide] in order to 'stretch' construction and

maintenance funds when AASHTO's own [safety guide] in 1974 strongly stated that 'The acceptance of minimum standards as the criteria for design too often occurred for reasons of economy. Frequently a more liberal design would have cost little more over the life of the project and would increase its safety and usefulness substantially. . . . The importance of the message cannot be overemphasized.' "

The Safety Board was further "concerned that the FHWA has not prepared . . . a comprehensive analysis that would determine alleged benefits to 'safety characteristics' from 'stretching' highway funds or that would project the losses in life, health, and property that are implied by the reduced safety margins. . . ." The Board called on the FHWA to conduct such an analysis and hold public hearings nationwide to determine the public reaction to the findings of the analysis.

Other commentors echoed the Safety Board's concerns. The Insurance Institute for Highway Safety and the Center for Auto Safety both opposed adoption of Alternatives 2 and 3. The Institute noted that adoption of AASHTO's lowered standards would "reverse the direction of highway engineering since the beginning of the Federal-aid program in 1916" and that this action was being proposed without adequate data or a cost/benefit analysis of its impact. The American Trucking Associations, Inc., opposed the adoption of Alternatives 2 and 3 and questioned how the proposals to lower design standards for RRR projects would affect the improvement of the Federal-aid Highway System. The American Automobile Association urged that no further regulatory action be taken until further study and investigation of the costs associated with reducing the standards. The Motor Vehicle Manufacturers Association urged the withdrawal of Alternatives 2 and 3, commenting that reduction of design standards would actually be "self-defeating with respect to economy. While construction to higher standards is more expensive initially, we believe these costs are more than compensated for by the consequent increase in useful highway life, safety and mobility."

In an unusual action, both the FHWA Assistant Chief Counsel for Motor Carrier and Highway Safety Law and the then FHWA Associate Administrator for Safety entered comments in the public docket, both strongly opposing the adoption of either Alternative 2 or 3. The Assistant Chief Counsel said that the adoption of either "would be tantamount to sacrificing safety on the altar of expediency." He cited several of the same specific areas of geometric design reductions that the Safety Board noted, and argued that "avoidance of tort liability appears to be a major consideration of many State highway departments who urge FHWA adoption of the lower AASHTO standards." The FHWA's adoption of such standards, "in a misguided attempt to minimize [State] exposure to tort liability . . . would be an act of moral bankruptcy to which FHWA should not be a party."

The then Associate Administrator for Safety commented that he found the AASHTO guide "repugnant," and he discussed at length specific design deficiencies which its adoption would permit. He challenged the notion that "stretching" highway funds by applying lower standards such as those in the AASHTO guide would be cost effective and said that "we are misleading the public to even infer that [project cost effectiveness analyses] will be performed" by States if they are not required by law. He repeatedly stressed his belief that minimization of tort liability exposure was the real motive behind the proposal to officially adopt lower design standards, and stated:

> Any [FHWA] Division Administrator or Washington representative that approves the construction of projects under RRR standards as proposed by AASHTO is, in my opinion, willfully approving projects that he knows are dangerous for the traveling public and, therefore, he and not the

> State highway department should be liable for his actions and the court[s] justifiably should find it so.

Finally, he said that there is "a need to reappraise the FHWA's relationship with AASHTO and its committees." He stated:

> The FHWA people who have been intimately involved with AASHTO committees working on these [RRR] standards have also been actively supporting the adoption of standards similar to these for the past 2 or 3 years. I am not convinced that our close relationship on the committee structure of AASHTO is in the overall public interest. We have a regulatory relationship with the State highway organizations. It certainly would not be in the public interest to have [FHWA's] Bureau of Motor Carrier Safety personnel act as members or secretaries to committees of the American Trucking Associations, Inc., nor on the Teamster committee structure. Certainly the Interstate Commerce Commission should not be on those associations either. How does AASHTO differ? It would be my recommendation that FHWA withdraw as members or secretaries from all committees of AASHTO and that we become no more than interested observers. Our role as regulators in my opinion demands it.

On January 19, 1978, (43 F.R. 2734) the FHWA withdrew the proposal. The announcement said that the FHWA's review of all the comments received caused it to conclude that "current criteria or procedures are not desirable and that some change is needed." As to Alternatives 2 and 3, the agency concluded "that the number of severely adverse comments [on the AASHTO guide] precludes its adoption for use on Federal-aid projects and, consequently, the adoption of either of those alternatives as such." The agency continued to believe, however, that "some other intermediate level of improvement" for deteriorating roads needed to be devised. The FHWA announced its intention to develop its own "geometric design criteria, separate from existing criteria for new construction." The notice argued that "separate national geometric design criteria" were needed "to assure that all factors, especially safety, are considered adequately and uniformly nationwide." The Safety Administrator's comments about the relationship between the FHWA and AASHTO were not addressed.

FHWA's Proposed Standards.—On August 23, 1978, (43 F.R. 37556) the FHWA published a Notice of Proposed Rulemaking (NPRM) (Docket 78-10) proposing its own design criteria for Federal-aid RRR projects. The criteria would have been applicable to all nonfreeway, Federal-aid RRR projects except those on Federal-aid urban collectors. The standards for Federal-aid RRR projects on these streets would be "those criteria acceptable to the local jurisdiction."

This notice said that the FHWA had reviewed the comments received on the first proposal, the legislative background, and the physical needs of the highway system and had concluded that it should not adopt the AASHTO guide for use on Federal-aid projects. The notice repeated the FHWA's belief that "to assure the future usefulness of the highway system and to assure that all factors, especially safety, are considered adequately and uniformly nationwide, RRR geometric design standards separate from existing standards for new construction and reconstruction are needed." Because "the FHWA would prefer to see one set of standards apply to all RRR work nationwide," the FHWA intended to ask AASHTO to adopt the RRR standards that the FHWA was proposing.

The notice discussed the question of safety at some length. The FHWA pointed out:

> The fact that the 1976 Highway Act amended the definition of the term "construction" to allow greater latitude in designing and constructing certain specific types of projects did not mean that other parts of the law were repealed or could be ignored, especially those on safety.

Citing the criticism that had been directed at "the apparent lack of emphasis on safety" in the AASHTO guide, the FHWA said that the new proposal "provides for safety throughout by encouraging the use of the highest practical design criteria, by requiring certain safety improvements such as on bridge approaches, and by requiring an analysis of the project's accident history to determine hazardous locations to be improved." The FHWA characterized the geometric standards it was proposing as "the minimums considered acceptable and . . . intended to provide the lower limit for applying engineering judgment in designing nonfreeway RRR projects."

Although the criteria proposed were not as high as those required on new construction or reconstruction, the "minimum acceptable" criteria for several design areas were upgraded from those proposed in the 1977 notice. For example:

> Bridge Approaches: "Because about 73 percent of errant vehicles at bridges impact either the approach railing or bridge ends, the proposed standards require that the approach barriers must always be upgraded to meet current [new construction] criteria."
>
> Grades, curvature, stopping sight distance: "Sites that have a known accident experience related to these geometric features must be corrected, preferably by reconstruction. If that is not possible, signs, markings and other devices, above and beyond the normal requirements, must be installed. If such measures have not worked adequately in the past at a particular location, then reconstruction is required.
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> Superelevation: "The superelevation criteria now applicable to new projects are also the basis for the superelevation on RRR projects. This eliminates the concerns expressed over the possibilities of extensive reversed 'banking' of curves under the [AASHTO] criteria proposed in the ANPRM. . . . The feasibility of rebuilding horizontal curves to larger radii and appropriate superelevation must always be considered, especially when accident data indicate that a problem exists."
>
> Lane and shoulder widths: The proposal would have set specific minimum lane and shoulder widths for rural two-lane, rural multilane, and urban arterial roads. The proposal notes that "the section on lane and shoulder widths has been modified to take into account the effects of various traffic conditions such as volume, and percentage of trucks and buses, and whether urban or rural conditions prevail." (emphasis added)

The 1978 proposal also would have required that, as a minimum, certain traffic data be collected and analyzed for all RRR projects to "allow the determination of the necessary level of improvements (i.e., RRR or reconstruction), establishment of necessary design elements such as pavement and bridge widths, and proper consideration for safety." The notice stressed that the proposed standards were intended as the "lower limit" for RRR projects and that they "should not be used automatically but only when higher values

are not possible or practical." The FHWA explicitly stated in this notice its theory that use of lower standards will provide, "in total, greater systemwide safety . . . by being able to improve more miles of highways."

This notice elicited more than 100 comments. Several States expressed reservations about the FHWA's upgrading of specific design criteria over those proposed by AASHTO, urging that they would be too costly. Only about 5 percent of the States commenting reflected general concern for the safety benefits of the proposal. One State observed that a great deal of judgment would be needed by the FHWA personnel approving RRR projects to determine if a reduction in geometrics should be approved on a given project.

The Insurance Institute for Highway Safety noted that highways built to current minimum standards have lower accident rates than older highways and that, given the acknowledged lack of data to determine the full impact of lowered standards, the FHWA should not adopt the proposal.

The Center for Auto Safety also noted that the FHWA had not provided data to support its contention that greater overall safety would be assured through use of lower standards. The Center also criticized the absence of a mechanism to ensure the consistent enforcement from State to State of the RRR criteria.

The Georgia Office of Highway Safety suggested that a 3-year accident rate on each proposed RRR project be compared to the national average rate for the type of road under consideration. If the road's accident rate were above the national average for similar roads, safety upgrading would be required, based on a traffic engineering analysis. If the road's accident rate were lower than the average national rate, either the AASHTO guide or the FHWA's proposed standards could govern the RRR project.

The Safety Board opposed the 1973 proposal on the same grounds that it had opposed adoption of the AASHTO guide: no analysis of the impact of lowering standards had been performed. The Board stated:

> The Safety Board would like to examine any study performed by the FHWA or a State that shows, in terms of injuries and fatalities, the different safety levels achieved by applying different levels of standards. If you have determined that "greater systemwide safety can be achieved" [by standards lower than those for new construction], such a determination must be based on a comprehensive study of the design criteria that will be applied to the Federally-funded RRR projects; otherwise, the statement is without foundation. The Safety Board is concerned that the FHWA is proposing to lower design criteria, which it admits will reduce safety on individual projects . . . without producing evidence for the public record to support the contention that overall safety will be enhanced.

The Board recommended that the FHWA continue to approve RRR projects that do not meet existing standards on an exception basis only, requiring "continued monitoring and evaluation of these projects after construction" to determine their effects on safety. Furthermore, the Board recommended that the FHWA "suspend all rulemaking that could reduce the safety effectiveness of any highway design standard" and pursue without delay "a comprehensive research effort to examine the design standard issues cited in the current rulemaking . . . to scientifically determine their relationship to safety and how incremental changes in a specific element . . . will affect safety."

The then Associate Administrator for Safety also submitted comments and the study by the Office of Highway Safety, Safety Impact of Resurfacing Rural Roads. Both his comments and the study were subsequently removed from the public docket by the FHWA Administrator.

On May 23, 1979, (44 F.R. 29921) the FHWA published a notice concerning the "status" of the RRR rulemaking effort. The notice reviewed briefly the history of the effort, describing the withdrawal of the original proposals (Docket 77-4) as being due to "the diversity of the comments" received. The agency said that it had decided to set up four working groups to assist in formulating a course of action. The working groups would, respectively, summarize the comments on the 1978 proposal (FHWA's proposed standards), evaluate these comments, prepare a "Regulatory Analysis" (presumably of the 1978 proposal), and prepare options for the FHWA Administrator's decision. The FHWA said that, before taking further rulemaking action, it would "fully assess comments received, along with the safety, cost, and social impacts of the rulemaking suggestion."

On May 30, 1980, (45 F.R. 37062) the FHWA published yet another statement on the RRR rulemaking effort, this time as part of the U.S. Regulatory Council's list of "major" rulemakings underway. The FHWA said that it considered this rulemaking "major" because of "the controversy over its possible impacts on safety and because the geometric design criteria proposed in the ANPRM would substantially affect the condition of the Nation's highway system." It characterized the "primary benefits of this program" as being "to prolong the life of the existing highway system and to enhance highway safety features," and claimed that its implementation would increase "the safety of drivers." This notice announced for the first time that a Draft Regulatory Analysis of the proposed regulation was available.

Current Proposal.—On January 5, 1981, (46 F.R. 1228) the FHWA withdrew the 1978 proposal and announced a new RRR proposal (Docket 80-3). It called for each State to devise its own RRR criteria, by agreement with the FHWA Division Administrator in each State, based on the AASHTO guide and other Part 625 standards. Under this proposal, "nationwide design standards would not be adopted." Essentially, the new proposal called for adoption of Alternative 3 suggested in the first RRR rulemaking notice and subsequently rejected in two later rulemaking notices (withdrawal of Docket 77-4 and announcement of Docket 78-10).

The proposal again reviewed the history of the rulemaking effort. It noted the "severe criticism of the AASHTO guide" that had been made in response to the first proposal, but did not note that both Alternative 2 and Alternative 3 had been withdrawn as a result of that criticism. The notice stated that although the FHWA believes the States and AASHTO "have an important role to play in the standards development process," the FHWA itself "has the ultimate responsibility for assuring that all Federal-aid projects, including RRR projects, are carried out in conformance with certain basic requirements for design and construction set forth by Congress" in 23 U.S.C. 109(a). 42/

The FHWA addressed the question of tort liability briefly, saying that while it "recognizes the concerns expressed in this regard, the agency's major concern and

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42/ This section, quoted earlier in this report, prohibits the FHWA from approving projects unless they will provide roads "that will adequately meet the existing and probable future traffic needs and conditions in a manner conducive to safety, durability, and economy of maintenance. . . ."

responsibility is the promulgation of policies and procedures to assure that RRR projects meet the requirements [for safety, durability, and economy of maintenance] in 23 U.S.C. 109(a)."

The notice characterized the earlier comments of the Safety Board, the Insurance Institute for Highway Safety, the Center for Auto Safety, and the Georgia Office of Highway Safety as being merely that "no action by FHWA might be better than action that creates a road that is not entirely safe." The FHWA did not mention the earlier comments of its Associate Administrator for Safety and its Assistant Chief Counsel for Highway Safety.

This notice also, for the first time, indicated that the FHWA regards RRR projects as in fact little more than maintenance activities, and indicated that Congress intended this:

> While the FHWA has provided funding to the States to aid in the construction of the Nation's highways it has always been the States' responsibility to maintain these highways once initial construction was completed. As highways began deteriorating at an increasing rate, Congress recognized the need to assist the States by providing funds for resurfacing, restoration, and rehabilitation work which had primarily been the States' responsibility to fund in the past.
>
> [Congress' authorization of the RRR program] allowed Federal-aid construction funds to be used for certain types of work which were previously considered to be maintenance.

The notice also described briefly a "technical report" which it said had been prepared by one of the working groups established after the 1978 proposal. This report, "RRR Alternative Evaluations for Non-Interstate Rural Arterial and Collector Highway Systems," was said to have evaluated "the application of the various RRR standards relative to both total system needs and projected funding levels" covering the period 1975 to 1990. The report had concluded, the notice said, that with limited funding, "RRR improvements would provide greater benefits nationally if [either] standards that more closely parallel" the FHWA's 1978 proposal or "current State practice for Federal-aid RRR work" are used.

The notice's proposed language to guide the implementation of State-developed RRR standards was general and brief. It first quoted the language of 23 U.S.C. 109(a) and said that RRR work "is an essential part of any highway program" and should be included. It noted that "RRR work may include upgrading of geometric features, such as minor roadway widening, flattening curves, or improving sight distances." "An important goal of the FHWA is to provide the highest practical and feasible level of safety," it said, and to "reduce highway hazards and the resulting number and severity of accidents on all the Nation's highways." It provided that "the only constraint on the application of Federal-aid funds to RRR work is that they must be used to provide a facility that adequately meets existing and probable future traffic needs and conditions in a manner conducive to safety, durability, and economy of maintenance, and acceptable levels of community and environmental impact." RRR projects, it said, "should be designed and constructed in a manner that will prevent deterioration of safety and yet accomplish the foregoing objectives . . . ." State-developed RRR standards "shall reflect the consideration of the traffic, safety, economic, physical, community and environmental needs of the projects."

In a discussion of the proposed language, the FHWA noted that the AASHTO guide would be acceptable for use under this proposal, and that, furthermore, States could

seek exceptions from even these lower criteria. The notice said that State's RRR standards need not "necessarily include specific, numerical standards" and that a specific project design "could be based on a variety of factors including traffic volumes, accidents, physical characteristics, functional classification, economics, and the potential impacts of various types of improvements." There was no indication in the proposal that such factors must be considered nor how they should be taken into account, although the notice said that a State's procedures "could indicate how these various factors would be considered . . . ." For example, the notice said, "a State could indicate that the choice of design criteria would depend upon the accident history of the highway section involved and the availability of funds for various types of improvements." (emphasis added)

Eighteen State highway agencies commented on this proposal; 14 generally supported it, 3 with reservations, 43/ and 4 opposed it. The New York DOT thought the AASHTO guide should be rewritten for FHWA approval and used for Federal-aid RRR projects, with exceptions permitted on a project-by-project basis. The Virginia highway agency said that the current procedures for RRR projects (new construction standards with exceptions permitted) are adequate. The Missouri agency felt that the FHWA should adopt the AASHTO guide and objected to the trend it perceived of the FHWA developing standards instead of AASHTO. The Maryland DOT seemed to support the continued use of current procedures, although the Maryland comments also referred favorably to use of the AASHTO guide, if it were modified by the FHWA.

The Insurance Institute for Highway Safety opposed adoption of this proposal, saying that it would cause more human and economic costs in the long run. The Center for Auto Safety submitted a lengthy analysis of the proposal, arguing in detail that its adoption would preclude the FHWA from assuring the safety, durability, and economy of maintenance of Federal-aid highways.

The Safety Board also opposed adoption of this proposal because "potential safety effects . . . have not been identified and evaluated." The Board said that it "is troubled by the lack of a systematic approach by the FHWA over the several years of this critical rulemaking" and that it has "repeatedly urged the FHWA to analyze and present to the public the safety impact of the various RRR proposals." The Board discussed the States' overall history of neglect of safety and maintenance, the probability of increased highway hazards in the future due to more travel and a more dangerous vehicle mix, and the FHWA-proposed elimination of safety improvement funds. The Board stated that, in its view, "it is essential that each section of road proposed for RRR work should be evaluated against specific uniform criteria to determine the safety impacts," and discussed five examples of criteria that it believed should be a part of the RRR program procedures. The Board's comments concluded:

> Since the Safety Board's first comments in 1977 on the FHWA's RRR program proposal, we have stressed the need to determine the benefits and disbenefits of the proposed program before proceeding to implement a final rule. The Safety Board has repeatedly stressed the need for collecting specific types of data to assist the FHWA in performing the required analyses. The FHWA has apparently made little progress in

43/ The Oregon DOT did not support the "provision requiring projection of future traffic volumes" because it is "secondary and unnecessary." The West Virginia Department of Highways also had reservations about the wording on future traffic needs. The Kansas DOT objected to the provision that the FHWA would have to approve State-developed RRR standards before their use on Federal-aid projects.

> identifying and analyzing the potential benefits and disbenefits that could result from the proposed changes or in attempting to define a systematic, effective Federal-State relationship for accomplishing the Congressionally-mandated highway safety improvement policies contained in the Highway Safety Act.

The Board recommended that RRR projects continue to be handled as new construction projects, with documented exceptions permitted, "until the FHWA has completed a safety assessment of RRR projects and developed a comprehensive program which meets the objectives discussed above. . . ."

On June 30, 1981, (46 F.R. 34183) the FHWA published another statement about the RRR rulemaking effort, as part of the Regulatory Information Service Center's "Calendar of Federal Regulations." This notice asserted that "continued application of [new construction standards with exceptions] has complicated and discouraged the use by States of Federal-aid funds for RRR improvements" and said that the "inconsistency (due to project-by-project exceptions) associated with the current process aggravate[s] the already serious problem of preserving and maintaining the Nation's highway system." It said that a final rule would be published by October 31, 1981.

Safety Board Efforts Seeking Clarification of Proposed Rule

On February 3, 1981, Safety Board staff attended an FHWA public meeting held to answer questions about the current RRR proposal and asked whether the FHWA has provided to its field Division Administrators criteria or guidelines for evaluating State proposals for RRR standards. The Chief of the FHWA's Highway Design Division said that the FHWA does not have nor does it intend to develop minimum criteria for use by its field personnel in determining the acceptability of RRR design policies proposed by States. Another questioner asked why the FHWA believes that nationwide RRR standards would be burdensome to the States when nationwide new construction standards are not considered burdensome. The Highway Design Division Chief said that there are more inequities involving "community impact" in the case of RRR standards.

The Safety Board staff has met with FHWA officials twice since publication of the most recent rulemaking proposal to discuss the RRR program. On April 3, 1981, Board staff met with the FHWA Associate Administrator for Engineering and Traffic Operations (who was also acting FHWA Executive Director at that time); the current Associate Administrator for Safety; 44/ the Highway Design Division Chief; and the Chief of the Program Evaluation Division of the Office of Highway Safety. At this meeting the FHWA told Board staff that the agency did not intend to delay the current RRR proposal despite the significant changes in the Federal-aid Highway Program being proposed by the DOT. They said that since the Office of Management and Budget has not directed the FHWA to develop a cost/benefit analysis of the current proposal, the FHWA has no plans to do so. If it were so directed, they did not know whether the public would be permitted to comment on the analysis and its effect on the proposed rule.

Safety Board staff attempted to determine whether and how the FHWA intends to ascertain if a project should be reconstructed or merely receive RRR improvements, but were unable to determine this from the FHWA officials' responses. The Highway Design Division Chief confirmed his earlier statement that the FHWA will not provide criteria to its Division Administrators for evaluating State-developed RRR standards.

44/ There have been only two Associate Administrators for Safety in the FHWA. The position was first filled in 1975; the first Safety Administrator retired and was replaced in 1979.

On June 10, 1981, Safety Board staff met with several FHWA officials to discuss the "technical report" which had been published as support for the current proposal. Because the technical report purports to address a central question with which the Board has been concerned throughout the RRR rulemaking--namely, what will be the safety and cost impact of using design standards lower than those for new construction?--the Board staff was interested in discussing its data and methodology with FHWA officials involved in its preparation. The Board's analysis of this document later in this report is based in part on discussions held during this meeting. FHWA officials who attended were: the Chief of the Safety Design Group and the Chief of the Systems Requirements and Evaluation Group, both in the Office of Research and both of whom were centrally involved in preparation of the technical report; an attorney from the Legislation and Regulations Division of the FHWA Chief Counsel's Office; and the Chief of the Geometric Design Branch in the Office of Engineering.

Among other topics, the Safety Board staff discussed with these officials the technical report's basic approach, clarification of the sources of the data used, the nature of the roads analyzed in the report, limitations and capabilities of the computer model used, the nature of the cost and safety benefit calculations, and the report's assumptions about the types and degree of improvements to be made to roads under varying design standards. The principal author of the technical report told Board staff at this meeting that all of the calculations made for the report were published in the report, and that it was written so that all of the assumptions and reasoning would be clear. Subsequent to this meeting, the Safety Board made several written inquiries about specific points in the technical report, in an attempt to clarify further the report's assumptions, data, and methodology.

ANALYSIS OF RULEMAKING RECORD

The rulemaking efforts undertaken by the FHWA during the past 5 years have not established the necessary basis for managing this large and potentially central Federal-aid Highway Program. The implementation proposals have all been narrowly confined to the question of what design standards should be required for RRR projects and have not even attempted to address the crucial larger question of what the appropriate role of the RRR program should be in the overall preservation and improvement of the Federal-aid Highway System for safety and durability. Even on the narrow question of design standards, the rulemaking record is contradictory, unsupported by fact, and seriously misleading to the Congress and the public.

Rulemaking Contradictions

The first proposal (Docket 77-4) offered three options for RRR design standards: new construction standards with project-by-project exceptions permitted; use of the AASHTO guide, consisting of broadly reduced standards; and development by each State of its own RRR design standards, based on the AASHTO guide. The latter two options were subsequently rejected and withdrawn by the FHWA, on the basis of the numerous strong criticisms of the AASHTO guide on grounds of safety.

In the second proposal (Docket 78-10), the FHWA offered its own RRR design standards, somewhat higher than those in the AASHTO guide but still lower than new construction standards. This proposal emphasized two points: (1) FHWA's conviction that "all factors, especially safety, [need to be] considered adequately and uniformly nationwide," that "one set of standards [should] apply to all RRR work nationwide; 45/

45/ As mentioned above, the June 30, 1981, notice also referred to the undesirable "inconsistency (due to project-by-project exceptions) associated with the current process."

and (2) the need to "[provide] for safety . . . by encouraging the use of the highest practical design criteria, by requiring certain safety improvements . . . and by requiring an analysis of the project's accident history to determine hazardous locations to be improved." The design standards the FHWA proposed were "the minimums considered acceptable" to the FHWA, "intended to provide the lower limit . . . in designing nonfreeway RRR projects."

In the third and current proposal (Docket 80-3), the FHWA has, without explanation or justification, abandoned all of the principles it found critical in the second proposal. Apparently, the FHWA no longer believes it should require that:

- "all factors, especially safety [be] considered . . . uniformly nationwide"
- "one set of standards apply to all RRR work nationwide"
- the "highest practical design criteria" be used
- "certain safety improvements" be made
- hazardous locations be identified and corrected
- specific road hazards, such as "extensive reversed 'banking' of curves," be corrected, even "when accident data indicate that a problem exists"
- the "minimum acceptable" standards in the second proposal be used
- the necessary information to determine "the necessary level of improvement (i.e., RRR or reconstruction), establishment of necessary design elements . . . and proper consideration for safety be collected and analyzed."

Instead, the FHWA has proposed to leave all such decisions up to the individual States. The proposal permits the States to apply the broadest sorts of "standards," without "specific, numerical" values, and, if desired, written uniquely for each project. The standards are explicitly permitted to be based on or to be identical to the AASHTO guide, previously rejected by the FHWA for safety reasons. Exceptions to these already low standards may also be approved.

The "inconsistency" and lack of "nationwide uniformity" which will result from such a proposal is made more certain by the fact that the FHWA has not developed, and has said it does not intend to develop, any criteria by which its State-level Division Administrators may evaluate "standards" proposed by each State (or exceptions to those standards requested by the State). The only guidance for evaluating State RRR policies is the statement in the proposed rule that "the only constraint on the application of Federal-aid funds to RRR work is that they must be used to provide a facility that adequately meets existing and probable future traffic needs and conditions in a manner conducive to safety, durability, and economy of maintenance, and acceptable levels of community and environmental impact." Excepting the last phrase, this is a restatement of the statutory language written by Congress that indicates the overall scope of the FHWA's funding approval responsibilities. Merely to repeat that language, however, is not to fulfill an executive agency's task of developing policies and criteria for program administration to ensure that Congressionally-mandated responsibilities are carried out. Even within this very proposal, the FHWA stated that "the agency's major concern and responsibility is the promulgation of policies and procedures to assure that RRR projects meet the requirements [for safety, durability, and economy of maintenance] in 23 U.S.C. 109(a)." (emphasis added)

Nothing in the rulemaking record supports these policy reversals. The Safety Board continues to believe that the FHWA's earlier-held principle that national consistency should be promoted in the application of Federal funds to the Federal-aid Highway System is the correct foundation for the program. That principle can be advanced through such mechanisms as national minimum design standards applicable to all projects, or through uniform procedures for making design decisions on all projects, or through some combination of these mechanisms. It will not be advanced through State-by-State development of standards, some on a project-by-project basis, controlled only by a broad mandate that the resulting projects must be "conducive to safety, durability, and economy of maintenance."

The Safety Board also agrees with the FHWA's earlier-held principle that safety improvements must be routinely and systematically considered in developing RRR programs and in deciding the nature of specific RRR projects to be performed. The Board is convinced that this principle will not be advanced through State-by-State development of standards to be approved by the FHWA through an unspecified, unstructured process. In general, the States do not have an impressive record of giving safety considerations appropriate priority unless required to do so by law and given specific Federal-aid funds for safety improvements. This fact has been recognized by Congress in the several Highway Safety Acts beginning in 1966 and in the legislative history of those Acts. It was extensively documented by the FHWA itself in a 1978 report on a nationwide review of Federal-aid projects. 46/ The most recent example of State attitudes toward safety is embodied in the AASHTO design guide for RRR.

At a time when many State highway departments feel they are financially hard-pressed, there is considerable incentive for them to view the RRR program as merely a Federal-aid supplement to their regular maintenance program. Indeed, the current FHWA rulemaking notice explicitly describes it as such. When the RRR program is described by the FHWA itself as a maintenance program, whose objective is "to restore pavement over as much of the two-lane rural highway system as possible," 47/ and whose highest safety goal is to "prevent deterioration of safety," it is highly unlikely that safety improvements, however badly needed, will be routinely and systematically considered in State-developed RRR standards. If they are not, it is unlikely that the extensive geometric and safety improvements that the Secretary's 1981 Report to Congress acknowledges the Federal-aid Highway System needs will be made, particularly if the DOT proposal to eliminate all safety improvement programs per se is adopted.

Rulemaking Unsupported by Facts

The central arguments of the FHWA throughout the RRR rulemaking effort have been that use of normal Federal-aid new construction standards and procedures for RRR projects "has complicated and discouraged" State use of non-Interstate Federal funds for RRR work and that, dollar for dollar, the use of lower standards will produce safer roads than the use of normal standards. Neither of these central arguments has been supported by the FHWA with facts.

FHWA accounting procedures permit very different conclusions to be drawn as to the proportion of Federal-aid funds obligated for RRR projects. Tables obtained from the

46/ Highway Safety Review: Report of the Safety Review Task Force to the Federal Highway Administrator, December 1978.
47/ FHWA, "RRR Alternative Evaluations for Non-Interstate Rural Arterial and Collector Highway Systems," p. 83.

FHWA's Office of Fiscal Services covering FY 1978 through FY 1980 48/ show obligations for roadway projects in at least three RRR-type categories: resurfacing; widening and resurfacing; and RRR. If one considers only those obligations coded "RRR," it can be said that only about 3.7 percent of total non-Interstate roadway obligations have been for RRR projects. If, however, one also considers the other two coded categories--resurfacing, and widening and resurfacing--State obligations for RRR projects have been averaging around 34 percent of total non-Interstate roadway obligations, rising from 33 percent in FY 1978 to 37 percent in FY 1980. This is a nearly 15 percent greater proportion of RRR obligations than the 20 percent that Congress set as a minimum in 1978. 49/ Considering the fact that most of these have been resurfacing or resurfacing and minor widening projects, which have a much lower cost per mile than most of the other Federal-aid projects counted in the "total roadway obligations," this 34 percent represents a substantial number of miles of RRR projects during this period. It is, then, unclear on what basis the FHWA claims that State use of RRR funds has been "complicated and discouraged" by current procedures.

The other major argument by the FHWA for lower RRR standards—that their use will in fact provide "greater systemwide safety" than higher standards because more miles can be "improved"—is also not supported by any evidence. This is one of the principal assertions that the Safety Board and other critics of the RRR proposals have repeatedly asked the FHWA to justify. The FHWA has not justified it, after nearly 5 years of rulemaking.

In January 1980, the FHWA initiated a nine-State before/after study of RRR projects in an attempt to determine "the benefits which accrue from various investment levels and combinations of improvements." The study description cites three examples of questions which the study would help to answer:

(1) what are the safety benefits of providing a 4-foot wide shoulder rather than a 2-foot shoulder;
(2) does simple resurfacing, without other improvements, have an effect on accident frequency or severity; and
(3) what design criteria should be used to provide an acceptable level of safety on low-volume roads?

The Safety Board has serious reservations about the value the study will have in assessing any safety impacts of the State RRR projects involved. The data elements to be collected on each project are so broadly phrased that only the most general information will be known about each project. For example, the States will be asked to indicate the "types of improvements" included in each project, but with no indication at all of the degree of improvement. "Shoulder widening" as a type of improvement will not indicate the amount of widening (from 2 feet to 4 feet, for instance); "change in superelevation will not indicate the amount of change; "pavement widening" will not indicate by how much the pavement has been widened. Thus, nothing would be learned about the safety effects of incremental design changes. Other study flaws include the fact that projects may be of "any length;" however, it is well known that changes in accident rates on short sections of road from one 1-year period to another 1-year period are not statistically reliable—typically, too few accidents occur on a given short section of road in a 1-year period to permit statistically valid comparisons. Furthermore, data on up to five improvements may be collected in a study section; in fact, more than five improvements may be involved, but in those cases the States have been instructed to ignore all but the "five most significant" improvements. It simply will not be possible to determine what

48/ FHWA, Office of Fiscal Services, Table F64, FY 78; Table F63, FY 79 and 80.
49/ 1978 Surface Transportation Assistance Act, Sec. 104(d)(1) and (2).

proportion, if any, of any purported accident rate increase or decrease is attributable to each of these improvements. Finally, it is considered essential by most accident data researchers to include "control sections" in any before/after study to account for traffic and/or accident rate changes that may be taking place during the study period that have nothing to do with the improvements made on the study section. Since this study does not include control sections, its results will be of little or no use.

The FHWA manager of this project has acknowledged to Safety Board staff that the study will not, in fact, be able to establish the incremental effects of different levels of design, as it was intended to do, nor will it be able to address what design criteria for safety should be used for low-volume roads. In any case, the project is not expected to provide even preliminary results until 1983. Thus, this study does not constitute the evidence that lower standards for RRR projects provide "greater systemwide safety" than higher standards.

ANALYSIS OF THE FHWA "TECHNICAL REPORT"

The FHWA study, "RRR Alternative Evaluations for Non-Interstate Rural Arterial and Collector Highway Systems" ("technical report"), was cited in the current rulemaking proposal (Docket 80-3) as supporting the regulatory analysis prepared for the rulemaking. The major conclusion of the technical report is that requiring the use of new construction standards. The Safety Board has analyzed this technical report in detail, reviewing its data and methodology several times with FHWA officials. The Board has concluded that the report's methodology is fundamentally unsound, its text is contradictory and misleading, and its major conclusion unsupported.

The basic approach of this technical report consisted of:

- Comparing a sample of roads to three levels of design standards;
- For each of three program budgets, determining how many miles could receive the improvements indicated necessary by the design standard under consideration;
- Estimating the safety impact of these improvements.

These data manipulations were performed by means of an already existing computer program, the Performance-Investment Analysis Process (PIAP) developed by the FHWA in the early 1970's to assist in preparation of the "highway needs studies" the DOT provides to Congress biennially. 50/

The PIAP program determined which improvements would be assumed necessary at a given program funding level and under a given design standard, at what point in the 16-year period the improvements would take place, and therefore how many miles could receive those improvements. The estimated cost of each of the improvement types was also built into the PIAP model. It should be pointed out that these PIAP decisions illustrate alternative, hypothetical 16-year highway programs; the FHWA will not necessarily implement any of them as policy.

50/ The PIAP model has recently been replaced by a new program, the Highway Performance Monitoring System (HPMS).

The sample of roads analyzed in the technical report, and their "profiles," were those submitted by the States in 1975 for use in preparing the 1977 highway needs study. The road "profiles" consist of geometric and other data about each mile of inventoried road. FHWA officials with whom Safety Board staff met did not know in what manner these data were collected by the States; the data collection manual provided by the FHWA to the States gives only broad, extremely subjective directions for rating such crucial geometric elements as horizontal curvature, vertical curvature, pavement condition, and for estimating current and future traffic volumes, current vehicle mix, and current speeds.

Because the FHWA decided to analyze the potential impact of RRR only on rural roads (although urban highways constitute about 16 percent of the Federal-aid system eligible for RRR funds), only rural non-Interstate sampled roads were used from the inventory. This sample of rural roads included both two-lane and non-two-lane highways. The sample, 280,506 miles of rural arterials and collectors, was said to be representative of the total 900,047 rural roads in 45 States (excluding Interstate and local roads). Since the sample is said to represent 900,047 miles of rural roads, and there are only 631,998 miles of Federal-aid rural (non-Interstate) roads, approximately one-third of the roads analyzed are not eligible for Federal-aid RRR projects. Thus, the relative safety and cost impact estimates for different levels of design standards are distorted to some unknown degree by the inclusion of these roads. 51/

Three Levels of Design Standards

The three levels of design standards applied in the report are called case 1, case 2, and mid-case. Case 1 standards are the highest used in the study; they are full new construction standards applied without exception. Case 2 standards are the lowest standards used in the study; they are those proposed by the FHWA in the second rulemaking proposal (Docket 78-10). The mid-case standards are assumed to be representative of "current State practices" in RRR projects.

The report cautions that the use of these standards in the report is not meant to imply that any of them will be "implemented as policy." An understanding of the three standards makes the validity of this caution clear. Case 1 standards are new construction standards applied without exception; but exceptions have been permitted on RRR projects since the inception of the program—indeed, it is the purported heavy burden of negotiating these exceptions that the FHWA cites as the reason for developing a set of lower standards for RRR projects. In fact, exceptions are frequently permitted even on new construction and reconstruction projects. Thus, use of case 1 standards in the report is not realistic.

The case 2 standards are those of the 1978 rulemaking proposal. Though they are used in the report to represent the "lower bound" (one of the report's authors said they are "the worst you could expect" on RRR projects), they have in fact been abandoned by the FHWA in the current rulemaking proposal in favor of State-developed standards that may be based on the AASHTO guide, a lower set of standards. Thus, the case 2 standards are not the real-world "lower bound."

51/ In general, non-Federal-aid rural roads can be assumed to be of lower geometric quality than Federal-aid rural roads, and typically of lower traffic volumes. To the degree that this is true, the number and degree of improvements needed to be made on these roads will be greater than on Federal-aid roads. Furthermore, the reductions in deaths and injuries resulting from the improvements will be less than for more heavily-traveled Federal-aid roads. The impact of these facts on relative costs and benefits will be much greater in the case of using higher design standards than it is in the case of using lower standards.

Even the assumption that the mid-case standards represent "current State practices" in RRR projects may not be valid. The description of current State practices used for the mid-case standards was developed around 1970 for the first highway needs study--that is, about 8 years before the technical report was prepared and about 6 years before there was a Federal-aid RRR program. Neither the authors of the report nor the FHWA's Office of Highway Planning could tell Safety Board staff if the mid-case is, in fact, representative of "current State practices" in RRR projects.

The report notes that "caution should be used when directly comparing the case 1 and case 2 [cost and safety] results with mid-case results." This is so for two reasons: First, the basis for the PIAP model's decisions about which improvements would be needed, and at what point in the 15-year period, is different for case 1 and case 2 than it is for the mid-case. The case 1 and case 2 improvement selections are based on pavement condition priority; the mid-case selections were "based on a combination of cost effectiveness and composite index priority." 52/ Second, the "high" and "low" program budget levels are different for case 1 and case 2 than for the mid-case: cases 1 and 2 assume a high funding level of $65 billion and a low of $47 billion; the mid-case assumes a high level of $67 billion and a low of $45 billion.

Despite these fundamental differences in the basic assumptions of the three cases, and the report's own cautionary note about making direct comparisons among them, the meat of the report is a series of direct comparisons among the cases, culminating in a final, sweeping comparison of the relative costs and benefits of the three cases.

The nature of the improvement categories used in the technical report is confusing, given the intended purpose of the report. The FHWA's official descriptions of the RRR program limit it to pavement improvement work (FHWA Notice N 5040.19), yet several of the improvement categories analyzed in the technical report are reconstruction projects (for example, "reconstruct same," "reconstruct as freeway," "reconstruct wider"). When Safety Board staff questioned the FHWA authors as to why such non-RRR improvement categories were included in the study, the FHWA responded that there was no choice but to include them, since they were built into the PIAP model's decisionmaking process.

Because the case 1 standards—new construction standards without exceptions--are set out in 23 CFR 625, the nature of improvements made under this case is reasonably clear. The case 2 standards, on the other hand, are not at all clear; they are said to be fairly close to those presented in the 1978 rulemaking proposal, but that proposal did not cover all geometric design elements and addressed others in rather broad terms. They were not applicable to reconstruction projects and not applicable to freeways. Thus, the nature of an improvement category such as "reconstruct as freeway" under the case 2 approach is difficult to imagine.

One of the more baffling aspects of the technical report is its application of the three levels of design standards. One of the fundamental issues in the RRR program debate has been, and continues to be, "To what level of design standards should RRR projects be constructed?" That is, given an existing road that does not meet current design standards and also needs pavement improvement, should it be required to be geometrically upgraded to new construction standards, or to some lower level of standard or not at all? It is that question that the technical report should have answered.

52/ For a description of what is meant by "composite index priority," see FHWA, Performance-Investment Analysis Process, September 1978, p. 5.

In fact, the technical report does not even address this question. The report's determination of "cost and safety impacts of applying different levels of standards to RRR projects" is derived using the following general approach:

> For case 1, the inventory of roads is compared to full new construction standards applied without exception; those aspects of the road that fail to meet these design standards are upgraded to full new construction standards applied without exception; the costs and safety impacts of doing this are calculated.
>
> For case 2, the inventory of roads is compared to the case 2 standards (the "lowest" standards); those aspects of the roads that fail to meet these design standards are upgraded to full new construction standards applied without exception; the costs and safety impacts are calculated.
>
> For the mid-case, the inventory of roads is compared to the mid-case standards; those aspects of the roads that fail to meet these standards are upgraded to full new construction standards applied without exception; the costs and safety impacts are calculated. (emphasis added)

This approach, of course, does not help to answer the question at issue in the RRR debate, namely, "To what level of standards should RRR projects be constructed?" The RRR debate has always assumed that road sections proposed for RRR work are compared to new construction standards to determine which aspects are geometrically substandard; the decision as to what level of standard those deficient aspects should be improved is the question that has been unresolved throughout 5 years of rulemaking. The techical report reverses this process--i.e., compares projects to three levels of standards, then upgrades deficient aspects to full new construction standards.

Such an approach not only does not begin to help answer the central RRR issue; it also produces unrealistic and biased cost and safety impact results. First, it exaggerates the differences in costs between case 1 and the other two cases; many more miles of roads will, obviously, fail the case 1 geometric standards than will fail the far lower standards of the mid-case and case 2, and thus the improvement costs of case 1 will be far higher. Second, such an approach would, if applied in the real world, produce some highly improbable roads. For example, the report assumes that a minor arterial road whose existing 2-foot shoulders fail the mid-case standards would be improved to have 10-foot shoulders. A minor arterial whose existing 0-foot shoulders fail the case 2 standards would be improved to have 10-foot shoulders. A minor collector road whose existing 8-foot lanes fail the mid-case standards would be improved to have 12-foot lanes. Such improvements would raise these geometric elements of these minor arterial and collector roads to match those of the Interstate System. Twelve-foot lanes and 10-foot shoulders are the lane and shoulder widths required on the Interstate System. To assume that any State highway department will make such improvements to minor rural roads is totally unrealistic. No one involved in the RRR debate has ever argued that such improvements are needed. The issue has always centered on such questions as, "Should a rural minor collector with substandard 8-foot lanes receive lane widening as part of a RRR project; if so, how much wider; and what factors should be taken into account in making these decisions?" Thus, the technical report does not address the central RRR issue.

The report's assumptions such as the ones described above also serve to exaggerate the safety benefits of the mid-case and case 2. Most of the safety benefits for the mid-case and case 2 approaches derive from the larger number of miles that will receive lane and shoulder widening in comparison to case 1. By assuming that lanes and shoulders will be widened to these unrealistic dimensions, the safety benefits of wider lanes and

shoulders are seriously exaggerated for the mid-case and case 2. They are also unrealistic safety benefits because of the way in which specific accident rates have been attributed to specific lane and shoulder dimensions.

In order to determine how many deaths and injuries could be prevented by widening some number of miles of lanes from X to Y feet, and some number of miles of shoulders from X to Y feet, the report attributes a specific accident rate to specific lane and shoulder dimensions. Thus, if a lane is 7 feet wide, it is assumed to have an accident rate of 4.16 accidents per million vehicle miles of travel over it; a lane 8 feet wide is assumed to have an accident rate of 3.66 accidents per million vehicle miles, and so forth. Similar specific, and progressively lower, accident rates are attributed to shoulder widths. Using these figures, the report assumes, for example, that if X number of miles of 7-foot lanes are widened to, say, 10 feet, the savings in lives and injuries can be calculated based on the difference in the assumed accident rates for the respective lane widths.

However, attributing specific accident rates to specific lane and shoulder widths is an extremely complex matter. The accident rate of a given shoulder width, for instance, is dependent on many variables, not least among them being the width of the lane adjacent to it, the volume of traffic using the road, the particular mix of vehicles on the road, and whether the road is two-lane, multilane, divided, or undivided. The same is true for the accident rates of a given lane width.

The accident rates attributed in the report to specific lane and shoulder widths were taken from a study performed in Kentucky. 53/ The rates used by the FHWA from this study were both determined and applied without taking into account corresponding lane and shoulder widths, traffic volume, vehicle mix, or traffic speeds. Furthermore, the Kentucky study was based on two-lane roads in one State, but the FHWA has applied the resulting accident rates to all the roads in the PIAP rural inventory, which, as noted above, contain an unknown number of non-two-lane roads in 45 States.

Thus, the safety benefits attributed in the technical report to the mid-case and case 2 approaches, which derive primarily from the greater number of miles which would receive widening and shoulder improvements under these approaches, are both exaggerated and unsound in their assumptions. They are exaggerated because if mid-case or case 2 standards were in fact adopted, based on the findings of this study, rural roads would not in fact be routinely upgraded to Interstate standards, as the report's calculations assume. They are unsound in their assumptions because the death and injury reductions attributed to these standards are incorrectly based on application of two-lane road safety calculations to all types of nonfreeway roads, and the calculations are themselves invalid because they do not take into account several crucial variables. 54/

53/ Charles V. Zegeer, "Cost-Effectiveness of Lane and Shoulder Widening of Rural, Two-Lane Roads in Kentucky," April 1979.

54/ The report similarly assigns specific accident rates to specific improvements in vertical alignment and in horizontal alignment, again with no account taken of other geometric standards on the road section, the traffic volumes, speed, and mix. Thus, in the improvement category "isolated reconstruction," the report calculates specific numbers of deaths and injuries that will be prevented by specific changes in vertical and horizontal alignment under this improvement category. The report says that these accident rates were taken from the same Kentucky study as the lane and shoulder width accident rates. However, the Safety Board could find no reference to such calculations in the Kentucky study; the author of the Kentucky study confirmed to the Board staff that no calculations or analysis of accident rates associated with specific improvements in alignment were made in his study.

Safety Impact of Resurfacing

The safety benefits attributed to the mid-case and case 2 approaches are open to question for a further important reason. The report assumes that resurfacing rural roads, without making any other improvements, will increase the accident rate by 2.2 percent. Therefore, the far higher proportion of miles receiving resurfacing-only in the mid-case and case 2 approaches is assumed to have only a negligible negative impact on accident rates and thus on numbers of deaths and injuries. But the analysis by which the conclusion of a net increase of only 2.2 percent was reached used a small data set and failed to explore several crucial questions.

The question of the safety impact of resurfacing-only projects is important in setting RRR policies and standards. Because the FHWA has described the objective of the RRR program as being to "resurface as much of the two-lane rural road system as possible" 55/ and because many States may, for economic reasons, be inclined to spend as much of their Federal-aid funds as possible for resurfacing projects without other improvements, it is important to know the effect of resurfacing-only on safety. There is, unfortunately, scant real-world data on this question.

FHWA Office of Highway Safety (OHS) Study of Resurfacing and Safety.--Aside from the fact that resurfacing-only projects do not address the hazards of substandard design or roadside fixed objects, some safety experts have contended that resurfacing a road results in higher traffic speeds, thus increasing the hazards of poor design or roadside objects, the numbers of accidents, and the severity of the accidents. This theory was discussed at length in the study Safety Impact of Resurfacing Rural Roads prepared and submitted by the FHWA Associate Administrator for Safety to Docket 77-4 but subsequently removed by the FHWA Administrator. The Safety Board obtained a copy of this study from the FHWA, accompanied by a letter from the Executive Director indicating that the FHWA "never formally reviewed, adopted or distributed" it. Furthermore, the letter said, "subsequent research and analysis contradict many of the predictions" made in the OHS study.

The OHS study noted that studies have been made in Great Britain that measured a "typical speed increase" of 6 miles per hour after resurfacing projects. Further, it said, "many resurfacing projects [in the United States] have been justified in whole or in part by anticipated reductions in travel time due to a smoother surface." The study pointed out that resurfacing often decreases the skid resistance of a road. 56/ The results of a Midwest Research Institute (MRI) study in 1978 showed that about half the resurfacing projects produced improved skid resistance and about half produced degraded skid resistance. Even if travel speeds do not increase after a resurfacing project, accidents could increase if there is decreased skid resistance, particularly if needed geometric improvements to flatten curves, widen shoulders, and improve superelevation are not simultaneously performed. If travel speeds do increase, of course, the skid accident hazards increase even more.

55/ Technical Report, p. 83.

56/ See also, National Transportation Safety Board, Highway Accident Report--"Midas Mini Motor Home/Automobile Collision, U.S. Route 69 Near McAlester, Oklahoma, July 14, 1977" (NTSB-HAR-78-2).

The OHS study focused largely on the findings of the MRI study, which found that there was an overall 15-percent increase in the rate of accidents after road sections were resurfaced. This increase was entirely due to the increase in dry-pavement accident rates. The MRI, after examining the data set carefully, concluded that the 15-percent increase in dry-pavement accident rates "must be attributed to . . . an effect of resurfacing such as an increase of vehicle speeds. . . ."

Using the 15-percent accident rate increase for resurfacing-only projects, the OHS study found that:

> The program option to upgrade [the Federal-aid Primary System to full standards] rather than to simply resurface [it] results in increased benefits to the public of $215 million for each $100 million invested.

* * * * * *

> The program option to upgrade [the Federal-aid Secondary System to full standards] rather than to simply resurface [it] results in increased benefits to the public of $97 million for each $100 million invested. 57/(emphasis in original)

The report concluded:

> These results suggest that the highway profession should reevaluate its already heavy reliance on resurfacing that does not include upgrading. Previously held beliefs that resurfacing produces only negligible safety and economic impacts should be modified in light of convincing recent studies which show significant accident increases. Work should be directed toward developing truly "optimized standards" based on evidence rather than flowery hollow statements. Relaxed standards which encourage wholesale resurfacing of substandard highways and which ignore the need to upgrade these facilities must be avoided. 58/

Technical Report Analysis of Resurfacing and Safety.—The technical report cites a 2.2 percent increase in accidents following resurfacing-only. This percentage was derived from an analysis of a subset of the MRI data, involving 59 sections of two-lane rural roads, covering 408 miles. The small size of this subset of data makes its analysis of uncertain reliability. Furthermore, although the technical report says that the 59 sections were taken from nine States, in fact nearly 75 percent of the mileage was concentrated in only four States: 16.02 percent in California, 18.61 percent in Michigan, 14.58 percent in North Carolina, and 24.33 percent in South Carolina. One of the nine States, West Virginia, contributed less than 1 percent of the mileage. Thus, data from basically four States have been extrapolated in the technical report to all the 45 States represented in the technical report. This sample's representativeness of resurfacing accident experience nationwide is extremely questionable.

57/ P. 15.
58/ P. 12.

The FHWA justified the use in the technical report of only 59 road sections from the MRI data on the grounds that only these 59 sections were rural, two-lane, and had received no improvement other than resurfacing. However, the FHWA later acknowledged to Safety Board staff that there were 24 additional sections of rural four- and six-lane highway that were also resurfaced; since the technical report's analysis was to be extrapolated to all kinds of rural roads, including four- and six-lane roads, it would seem logical to have used these 24 sections also. The FHWA told Board staff that these sections were excluded from the analysis because the codes used to identify the nature of the improvements did not reveal whether the improvements were "resurfacing only" or "resurfacing with shoulder improvements." However, this raises questions as to whether this distinction was made even for the 59 sections used by the FHWA for its analysis.

Whatever the reasons for the FHWA's selection of those specific 59 sections, the basic finding of the technical report's analysis of their accident experience is that 36 of the sections experienced an increase in accidents, while 23 experienced a decrease in accidents. 59/ On average, these decreases and increases resulted in a net 2.2-percent increase. The difference between this small increase and the 15-percent overall increase found in the MRI's analysis of a much larger data set suggests that a more careful look at the data should have been performed to discover why there is so much difference. For example, the MRI separately calculated the wet-pavement and dry-pavement accident rate increases and decreases and found, as noted above, that overall there was no change in the wet-pavement accident rates before and after resurfacing; however, on dry pavements there was a net 15-percent increase. The MRI tested several hypotheses in an attempt to explain the dry-pavement accident increase and finally concluded it "must be attributed to . . . an effect of resurfacing such as an increase of vehicle speeds. . . ." The FHWA technical report made no attempt to calculate the wet-pavement versus dry-pavement accident rate experiences to see if a similar conclusion must be reached about the subset of 59 sections.

The technical report also did not attempt to determine whether certain types of accidents increased or decreased after resurfacing. For example, if skidding accidents decreased on a section of road, yet the overall accident rate remained about the same, then other types of accidents, perhaps related to increased travel speeds, must have increased (run-off-road, hit fixed-object, overturn, etc). If skid resistance were always improved by resurfacing projects, and were always improved enough to offset these increases in other accident types, such trade-offs might not be important to calculate. However, since resurfacing may often result in lower skid resistance, it is extremely important to know (in making calculations to be used in the real world) whether speed-related, nonskid accidents are increasing after resurfacing, since they will be added on to increased skid accidents in many real-world resurfacing projects.

The technical report, furthermore, did not attempt to determine the geometric "profile" of the sections that experienced decreases and increases. If, for example, a road section has wide lanes, wide paved shoulders, good vertical and horizontal curvature, and few roadside objects, it would not be surprising to find it experiences no change in the

59/ In a March 1981 article in the FHWA magazine Public Roads, one of the authors of the technical report describes the analysis of the 59 sections' accident experience. Although 36 of the sections experienced an increase in accidents, some of them quite substantial, and 23 experienced a decrease, the author concludes that "the analyst should not estimate an increase or decrease in accidents as a result of only resurfacing two-lane rural highways."

accident rate after resurfacing. If most of the 23 sections that experienced a decrease in accidents were of high geometric standards, averaging in these decreases for application to all the rural mileage in the country, most of which is not of high geometric standards, produces distorted and misleading results that are of no value in judging the future nationwide effects of using the broad standards studied in the FHWA analysis.

All that the Safety Board can conclude from review of the MRI study and the two FHWA reports is that in some cases resurfacing has been followed by an increase in accidents, in some cases by a decrease. The technical report has not resolved this crucial issue. However, the fact that three studies based on the MRI data in full or in part have reached very different conclusions regarding net changes in accidents after resurfacing clearly indicates that its safety impact remains unknown. No study of RRR alternatives can be used for determining the safety impact of RRR policy decisions without an adequate resolution of this point. The amount of resurfacing that is projected by the FHWA and that can be expected to occur under the RRR program is substantial and the questions raised about the negative impact on safety is so great that the Board can only reiterate that a more extensive analysis needs to be done to resolve this important question.

Finally, even if the 2.2 percent figure were incontrovertible and even if the FHWA could show that there is zero percent net change in accidents after resurfacing, the Safety Board would continue to be very concerned. Skidding accidents alone are a large and rapidly increasing cause of highway death and injury. For the FHWA to move ahead with a Federal-aid resurfacing program that even the agency itself believes will not reduce the numbers of these deaths and injuries is beyond understanding.

Distortions in Resurfacing Costs and Safety Benefits

The major conclusion of the technical report is that, at any of the projected program budget levels (except unlimited funding), both the mid-case standards and case 2 standards would produce more safety benefits for less cost than case 1 standards. In fact, however, the costs of the mid-case and case 2 have been understated and the safety benefits have been exaggerated.

The technical report's results are possible only if one assumes that all roads in the inventory will be resurfaced only once during the 16-year period. Since resurfacing typically lasts only 5 to 8 years, and then must be repeated, the Safety Board has calculated the more realistic costs and safety benefits of the three cases, accepting the report's assumptions of costs-per-mile for these improvements and the report's designation of the points in time at which "chunks" of mileage will receive the improvement.

If, for example, one assumes an 8-year life for resurfacing and, therefore, that the 50 percent of the total mileage that receives resurfacing during the first 8 years of the period must be resurfaced once more during the time frame of the study, the following results are reached:

> —Under the low investment level, either the case 1 construction costs would increase by $0.1 billion (putting it $0.1 billion over budget level), or the number of miles resurfaced would drop from 2,002 miles to 1,001 miles.

--Under the low investment level, either the case 2 construction costs would increase by $2.9 billion (putting it $2.9 billion over budget level), or the number of miles resurfaced would drop from 69,240 miles to 34,620 miles.

--Under the high investment level, either the case 1 construction costs would increase by $0.15 billion, or the number of miles resurfaced would drop from 2,629 miles to 1,314.5 miles.

—Under the high investment level, either the case 2 construction costs would increase by $4.5 billion, or the number of miles resurfaced would drop from 102,030 miles to 51,015 miles.

It is obvious that if one assumes a realistic life expectancy for resurfacing projects, for both the low and high investment levels, the real costs of the case 2 approach are raised substantially ($2.9 billion and $4.5 billion, respectively), while the real costs of the case 1 approach are barely increased ($0.1 billion and $0.15 billion, respectively). Of course, if one assumes that the two investment levels may not be exceeded, then the decrease in the number of miles to be improved under case 2 is much greater than the corresponding decrease in case 1 (i.e., at low investment level, only 1,001 miles in case 1 compared to 34,620 miles in case 2). (See table 3.)

Table 3.--Changes in numbers of fatalities and injuries used by FHWA "Technical Report" for resurfacing only and resurfacing and shoulders.

Category	Miles		Change in Fatalities		Change in Injuries	
	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2
Resurfacing Only	2,002	69,240	+15	+653	+462	+18,177
Resurfacing and Shoulders	4,222	15,305	-820	-3,420	-23,027	-94,808

Derived from RRR Alternative Evaluations for Non-Interstate Rural Arterial & Collector Systems. FHWA, Office of Research, March 1980, p. 24, and supporting documents.

If one assumes a 5-year life expectancy for resurfacing projects, the results are even more dramatic:

--Under the low investment level, either the case 1 construction costs increase by $0.21 billion, or the number of miles resurfaced would drop from 2,002 miles to 667 miles.

--Under the low investment level, either the case 2 construction costs increase by $6.1 billion, or the number of miles resurfaced drop from 69,240 miles to 23,181 miles.

—Under the high investment level, either the case 1 construction costs increase by $0.2 billion, or the number of miles resurfaced drop from 2,329 miles to 876 miles.

—Under the high investment level, either the case 2 construction costs increase by $9.5 billion, or the number of miles resurfaced drop from 102,030 miles to 34,010 miles.

Again, the increases in construction costs under both low and high investment levels are relatively small for the case 1 approach ($0.21 billion and $0.2 billion, respectively), while the cost increases for the case 2 approach are substantial ($6.1 billion and $9.5 billion, respectively). Again, the decreases in number of miles to be improved under case 2 are much greater than the decreases in miles improved under case 1.

Both the cost and safety implications of the mid-case and case 2 are also distorted in the "resurfacing with shoulder improvements" category. Again, many more miles are assumed to be improved under case 2 and the mid-case than are assumed to be improved under case 1, and much of the mid-case and case 2 safety benefits derive from the large number of miles of shoulder widening. (See table 3.)

The technical report assigns approximately the same cost-per-mile for shoulder widening and for resurfacing in this combined improvement category. Thus, about half the total cost-per-mile of this improvement is the shoulder-widening cost, about half the resurfacing cost. If one assumes that new, wider shoulders have a normal design life of 20 years and therefore will not need to be redone within the 16-year period, and if one assumes that resurfacing, on the other hand, has a design life of 8 years, and thus must be repeated once more during the 16-year period, the total cost-per-mile of this combined improvement increases by 50 percent. That is, on a given 1-mile section, there will be the costs of the shoulder widening, an equal cost of the first resurfacing, and a third equal cost of the second resurfacing. Thus, given an 8-year life for resurfacing, this improvement category's real costs are about 50-percent greater than indicated in the report, or else one-third fewer miles will be improved. If one-third fewer miles are improved, the safety benefits attributed to this improvement must be reduced by one-third. The impact on cost and safety of assuming a 5-year design life for resurfacing in this improvement category would be even greater.

It is unclear why the FHWA chose to assume only one resurfacing during the 16-year period, since it is well-known that resurfacing typically lasts between one-third and one-half that long. It is true that that assumption permitted the costs of the mid-case and case 2 approaches to stay within the projected budgets and permitted the alleged safety benefits to appear much greater than those of case 1.

Distortions in Costs and Safety Benefits of the Case 1 Approach

The technical report not only has understated the true costs of the case 2 and mid-case approaches, and overestimated their true safety benefits, it has also seriously understated the safety benefits of the case 1 approach and overstated its costs.

Under the case 1 approach, elements of a road that fail to meet full new construction standards are upgraded to full new construction standards applied without exception. Thus, all the miles of roads improved under the case 1 approach are brought to full new construction standards. The design life of these improvements is, as it is for new construction, about 20 years. This means not only that a mile of case 1 improvements

done in the first year of the 16-year period will provide its full safety benefits throughout the 16-year period but that it will continue to provide benefits for at least 4 more years. A mile of case 1 improvements done in the last year of the 16-year period will contribute 19 more years of safety benefits after the budgeted 16-year period ends. During the 4 years following the close of the 16-year period, all the miles of case 1 improvements will be contributing all their safety benefits. After those 4 years, those miles improved during the first year of the 16-year period will have reached their design life, but it will be at least 16 more years before all the safety benefits of the case 1 approach will have been realized. 60/

The technical report ignores the 20-year design life of the case 1 improvements and attributes to the case 1 approach only those safety benefits which it will accrue during the 16-year period, rather than the 36-year period during which it will actually provide safety benefits. For the 16-year period, the technical report attributes 14,484 lives saved to the case 1 approach. Extrapolating the report's figure to the full 36-year life of this approach, however, results in a figure of 36,208 lives saved--that is, 2.50 times as many as the technical report attributes to case 1.

Figures 1 and 2 illustrate the minimum number of lives saved and injuries reduced under the case 1 approach, based on FHWA calculations extrapolated to the full (minimum) life of the case 1 improvements. Between points (A) and (B) (16 years), projects are being completed each year, with accumulating benefits. Between points (B) and (C) (4 years), full benefits from all case 1 improvements are being accrued. Point (C) to (D) reflects declining benefits as projects reach and exceed their design life. Moreover, the safety benefits from improved road geometrics can be expected to continue past the 36-year period depicted. The overall safety of the case 1 roads will be affected by the level of pavement maintenance they receive and the general pavement condition, and by changes in the volume and vehicle mix of traffic.

If the 36-year projected savings in injuries reduced are also calculated, and are combined with the fatalities reduced, then the cost/benefit ratio for the case 1 approach changes from 0.60 to 1.5. (See table 4, page 40.) Therefore, the benefits of the case 1 approach are 1 1/2 times the cost.

It is possible to calculate these long-term benefits of the case 1 approach, as the Safety Board has done, because the nature of the roads as improved under this approach is known: they meet new construction standards in all respects. To calculate the long-term benefits of the case 2 approach is not possible, based on the information provided in the technical report. Because only some aspects of the road receive improvement to new construction standards under this approach, it is impossible even to speculate about the design life or the safety contributions of roads receiving these undefined assortments of improvements.

As discussed above, the technical report counted all the costs of the case 1 approach and allocated them to the 16-year budget period. At the same time, the report failed to count all the safety benefits of case 1, benefits which continue to accrue long after the budget period ends and which--using the report's own calculations--result in a cost/benefit ratio about two and a half times greater than the report alleges. Furthermore, the technical report did not take into account the substantial economic benefits of increased traffic capacity and reduced travel time and operating cost that would be

60/ In fact, assuming traffic volume and mix have not exceeded design volume and mix, even after 20 years roads improved to new construction standards will continue to provide safety benefits through superior geometrics, even if the pavement requires improvement.

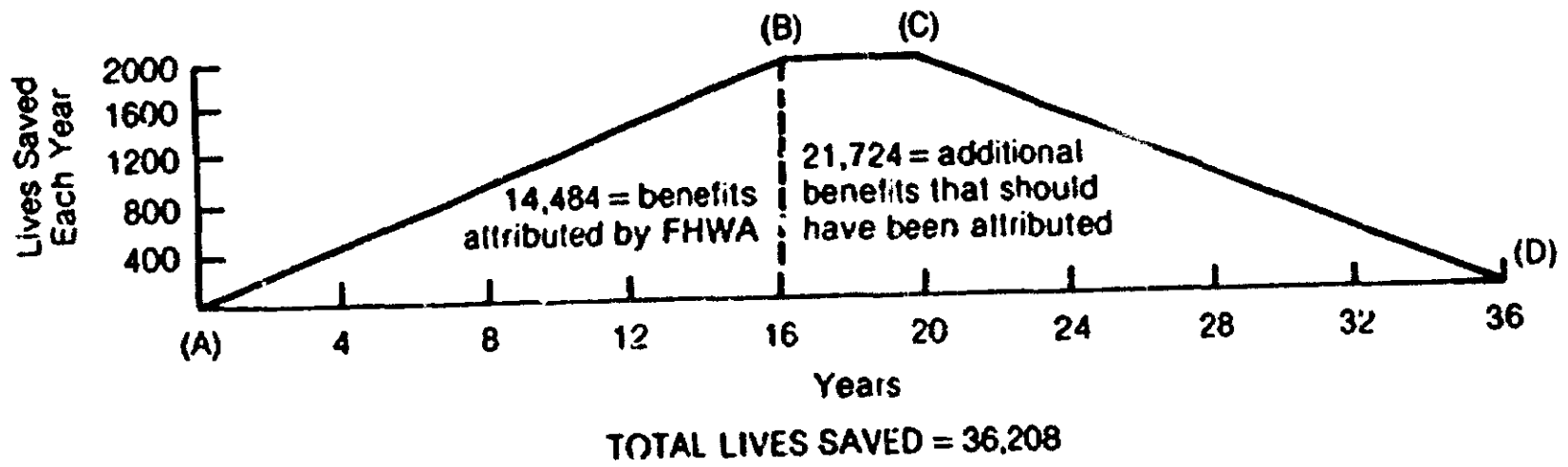

Figure 1.—Case 1 safety benefits (lives saved), assuming 20-year design life.

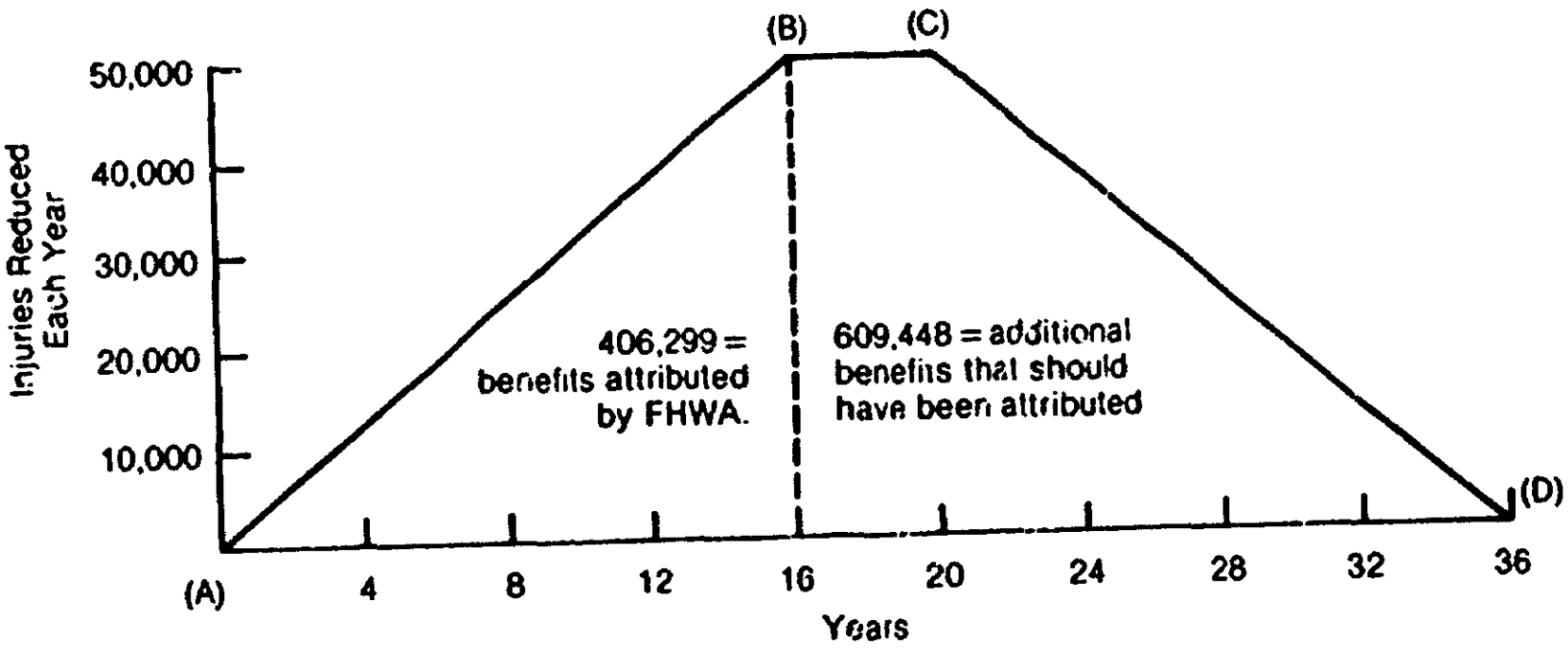

Figure 2.—Case 1 safety benefits (injuries reduced), assuming 20-year design life.

Table 4.—
(Reproduction of Technical Report's Table 20, page 70)
Table 20.—Summary of costs and savings in billions by case analyses for 46 agencies.

Case	Investment level	Construction costs	Other costs			Accident savings	Other savings			Total savings	Ratio total savings to construction costs
			VOC[1]	VTT[2]	Maintenance		VOC	VTT	Maintenance		
1	Full needs	$347.7	$715.9	$247.4	$12.0	$56.0	$50.6	$32.3	$6.6	$145.5	0.42
Mid	Full needs	219.5	703.3	251.5	11.6	39.17	63.2	28.2	7.0	137.6	0.63
2	Full needs	142.8	694.0	255.8	10.9	21.7	72.5	23.9	7.7	125.8	0.88
1	High	65.0	743.6	271.3	17.6	6.7	22.9	8.4	1.0	39.0	0.60
Mid	High	67.3	712.3	262.9	16.4	8.16	54.2	16.8	2.2	81.4	1.21
2	High	65.0	729.0	261.3	16.4	7.9	37.5	18.4	2.2	66.0	1.02
1	Low	47.0	750.3	272.4	17.9	4.7	16.2	7.3	0.7	28.9	0.61
Mid	Low	44.9	736.8	266.7	17.1	5.31	29.7	13.0	1.5	53.3	1.10
2	Low	47.0	737.8	267.7	17.1	5.4	28.7	12.0	1.5	47.6	1.01
-	None	0	766.5	279.7	18.6	--	--	--	--	--	--

1/ VOC = Vehicle operating cost

2/ VTT = Vehicle travel time cost at $1.50 per vehicle-hour

Note: Savings for VOC, VTT, and maintenance for each investment level are computed by compering each to the same items cost at no dollar investment level.

accrued under the case 1 approach. Such operating benefits as wider lanes, increased travel lanes, reduced vertical curvature, improved horizontal curvature, and enhanced passing sight distances can be substantial, particularly for commercial trucking and busing, and should be accounted for in calculating the cost/benefit relationship of case 1.

SUMMARY

The Federal-aid RRR program is a large part, and in the future may be the major part, of the Federal-aid Highway Program. By authorizing the use of Federal-aid funds for resurfacing, restoration, and rehabilitation of the Federal-aid Highway System, the Congress clearly intended to promote the salvage and continued usefulness of existing pavements. However, several facts make it equally clear that Congress did not intend for the Federal-aid Highway Program to become merely a Federal-aid resurfacing program; nor did it intend that efforts to improve and upgrade the safety of Federal-aid roads be relaxed. The Senate's description of "restoration and rehabilitation" projects explicitly included the addition of "elements . . . necessary to incorporate design or safety standards adopted since construction of the original pavement." The House report's statement that the new RRR authority was to be "coupled with the Secretary's existing authority on standards" links the RRR program with existing safety requirements. Importantly, Section 101 of 23 U.S.C. was amended in 1973 to include the following statement:

> It is further declared that since the Interstate System is now in the final phase of completion it shall be the national policy that increased emphasis be placed on the construction and reconstruction of the other Federal-aid systems . . . in order to bring all of the Federal-aid systems up to standards and to increase the safety of these systems to the maximum extent. (emphasis added)

The FHWA has no overall policy to describe the appropriate roles of new construction, reconstruction, safety improvements, and pavement preservation. Without such a policy, the Congress and the American public cannot be reasonably assured that the short- and long-term improvements needed to be made on the Federal-aid Highway System will be performed, and performed in a reasonably timely and economical fashion. Without such a policy, the FHWA cannot fulfill its statutory obligation to assure the Federal-aid Highway Program provides facilities that are "conducive to safety, durability, and economy of maintenance." The FHWA cannot fulfill the Congressional directive to place "increased emphasis . . . on the construction and reconstruction" of the system, in order to "bring all of the Federal-aid systems up to standards and to increase the safety . . . to the maximum extent."

To manage the expenditure of Federal funds for RRR projects, the FHWA has produced a series of rulemaking proposals unsupported by facts and mutually inconsistent in their basic assumptions. The basic concept embodied in the current proposal had been explicitly rejected in two earlier rulemaking notices for reasons of safety and the need for national consistency. The various proposals' basic assumption that greater systemwide safety can be achieved through use of lower standards has not been supported.

The current rulemaking proposal is unacceptable for a number of reasons. It will result in inconsistency from State to State and from project to project, thus precluding, among other things, the ability to make sound evaluations of the cost and safety benefits of the RRR program. It permits the use of the AASHTO design guide for RRR, rejected earlier for safety reasons and whose full impact on deaths and injuries has not yet been analyzed. The current proposal provides no criteria for determining whether the type and quality of work that may be proposed by a State are even cost-effective. For example,

there are no requirements that a State demonstrate that it has reviewed the accident history, maintenance history, current and anticipated traffic volume (including percentage of small cars and heavy trucks/buses), and other relevant facts to decide on the optimum treatment. There are no criteria to prevent a State from resurfacing an existing skid-prone road with new skid-prone pavement (a common occurrence now, according to Safety Board studies, the FHWA's 50-State safety review, and the MRI study). No criteria have been proposed for deciding when a State's proposal merely to resurface a road is inappropriate, when in fact more substantial improvements or even reconstruction is in order. No plan has been proposed for monitoring the effects of federally-funded, State highway programs on overall system condition and safety.

The current proposal makes no provision for systematically collecting much-needed data on the relative construction costs, safety impact, maintenance costs, and anticipated durability of various levels of design and various combinations of improvements. In 1978, the FHWA acknowledged (Docket 78-10) that "the existing research does not provide reliable information on the full impact of variances in individual design criteria," but assured the public that "many remaining questions will be answered and problems resolved by future research, development, and evaluations." The only study underway in the FHWA, after 5 years of rulemaking, that might answer some of these questions is now acknowledged by the FHWA to be unable to answer them. Yet the current proposal makes no provision for collecting the data that could be generated through the RRR program. It is, of course, dismaying that after 50 years of roadbuilding experience and many billions of Federal road construction dollars later, so little is in fact known about the durability and safety characteristics of various design elements.

Beyond this, the Safety Board can find no evidence that the FHWA even has accurate knowledge about the current practices being used to carry out the RRR program. FHWA officials have acknowledged to Board staff that they do not know what current RRR practices are, although certain design standards were described in the RRR technical report as representative of "current practices." So far as the Board can determine, the FHWA has spent 5 years proposing a series of various RRR approaches, without even ascertaining, on the national level, what exceptions from current design standards for RRR projects are being requested by each of the States; what exceptions are being granted by each of the FHWA Division Administrators; on what bases the exceptions are sought and granted (or denied); and what impact these exceptions may be having on safety, cost, and durability. The Safety Board recommended to the FHWA, in comments on two RRR rulemaking proposals (Dockets 78-10 and 80-3), that exceptions to current design standards should continue to be granted only through a "thoroughly documented review and approval process." The Board continues to believe that such information is essential for a rational development of the RRR program.

The Safety Board believes that the FHWA should not avoid its responsibility to adopt a systematic, business-like approach to ensure the consideration of safety and long-term road durability needs in the Federal-aid Highway Program and the RRR program as part of it. If it is not possible to bring all RRR projects up to new construction standards, it is essential that each section of road proposed for RRR work be evaluated against specific uniform criteria to determine the safety impacts. These criteria should include:

1. Criteria for the types of information that should be used in analyzing the condition and operational characteristics of segments of roadways to be considered for improvement. The information should include such factors as structural condition, geometric design, presence of high hazard locations, accident experience, traffic volume, and vehicle mix.

2. Criteria for analyzing the foregoing factors and setting priorities for improvements. Such criteria should include a measurement of safety level (for instance, a comparison of the road's accident experience to the average accident experience on roads of similar geometric and operational characteristics in the State) for use in determining what safety improvements will be necessary, if any, in an RRR project. The criteria should also require an analysis of all factors to determine how much improvement--from mere resurfacing to full reconstruction--is appropriate for safety- and cost-effectiveness.

3. Criteria should be developed to ensure that those basic design elements with significant safety benefits are included in all RRR projects, unless the State can demonstrate that they would not be cost-effective on a particular project. (For example, lane width, shoulder width, horizontal/vertical curvature, superelevation.)

4. Criteria should be established for the systematic collection of data about the relative construction costs, safety impacts (including rates of death/injury/property damage) and safety costs, (i.e. medical, disability, productivity, property losses, etc.), maintenance costs, and durability of various levels of design and various combinations of improvement types.

5. An integral part of the RRR program must be the development and publication of a plan for monitoring the States' programs for conformance to the minimum criteria established for work performed under Federal-aid RRR funds.

In addition to setting forth these kinds of minimum criteria for Federal participation in RRR work, the FHWA should develop and publish an explicit plan for monitoring the effects of State highway projects, including RRR, on system condition and on safety. As noted above, the DOT Secretary's 1981 Report to the Congress stated that it will be necessary to monitor the RRR program to determine its effects on pavement conditions. However, none of the FHWA RRR proposals since 1977 has described a plan for doing this. Although the FHWA's Highway Performance Monitoring System (HPMS) may be able to provide generalized information on overall effects of the RRR program, much more detailed knowledge is needed on the effects of specific State RRR practices, particularly if each State is permitted to determine its own practices. As for safety effects, the HPMS does not gather any data about the accident experience of the road segments monitored, and no other plan for collecting this crucial information has been developed by the FHWA. The 50-State safety review by the FHWA in 1978 found:

> Local accident information that could and should be available and evaluated to determine the best solution for the specific problem were seldom used.... In a number of instances design, maintenance and management personnel of both FHWA and the States lacked familiarity with the available data and how it might be used to determine needed improvements. 61/

Finally, the FHWA must unambiguously define the following terms: reconstruction, resurfacing, restoration, rehabilitation, maintenance, improvement, and betterment. There is now nearly total confusion, even among the best informed highway officials, as to the distinctions among these terms. Because there are said to be important differences in

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61/ Highway Safety Review: Report of the Safety Review Task Force to the Federal Highway Administrator (December 1978), p. 7.

the design requirement for these activities, and because the legal and funding responsibilities for maintenance still rest with the States, these terms must be clearly defined.

In recent years, there has been considerable emphasis on regulatory review to ensure that Federal regulations and program management criteria are both cost-effective and cost-beneficial. The Safety Board believes that the regulations and program requirements for the RRR program, a growing and potentially substantial part of the Federal-aid Highway Program, should receive particular scrutiny at this time. The Federal-aid Highway System is an important part of the nation's overall highway network, and it plays a crucial role in the strength and stability of the nation's productivity and general economic health. Similarly, the toll of highway deaths and injuries has serious implications for our economy and productivity (currently, the societal losses from highway crashes are estimated to be between $14 billion and $36 billion annually). 62/ The development of Federal policies and criteria for the proper management of the RRR program, which will have potentially major effects on the short- and long-term durability and safety of our highways, should be of great concern to policymakers at the Federal and State levels. The only cost-benefit analysis of the RRR program proposals that the FHWA has produced, after 5 years of requests by the Safety Board and others, is distorted, misleading, and inaccurate. The Safety Board, therefore, believes that the Office of Management and Budget should review the RRR rulemaking proposal, the technical report used by the FHWA to support it, and the Safety Board's analysis of both of these.

Until such time as the FHWA has developed appropriate implementation proposals for the RRR program, and has produced an adequate analysis of the proposal's likely impact on cost, safety, and system durability, the Safety Board believes that the Congress should consider placing an appropriate limit on the amount of Federal-aid funds which may be obligated for RRR projects on the Federal-aid Primary, Secondary, and Urban Systems.

Finally, the Safety Board reiterates the recommendation we have made to the FHWA in Board comments on the RRR rulemaking proposals: that until a sound analysis of the proposed RRR program has been performed, RRR projects should continue to be based on current design standards, with exceptions permitted if their basis and predicted impact are documented for review.

CONCLUSIONS

1. The Federal Highway Administration (FHWA) has not fulfilled its responsibility, as steward of the Federal-aid Highway Program, to develop clear policies and procedures to ensure that the Federal-aid Highway Program will be "conducive to safety, durability, and economy of maintenance" through a balanced combination of new construction, reconstruction, safety improvements, and resurfacing projects.

2. The FHWA has failed to develop design standards for resurfacing, restoration, and rehabilitation (RRR) projects based on reliable research that would provide a basis to measure their safety impact.

3. The FHWA has not provided timely, accurate, and objective information to Congress and the public about the policy alternatives available for the short- and long-term improvement and preservation of the Federal-aid Highway System.

62/ "The Incidence and Economic Costs of Cancer, Motor Vehicle Injuries, Coronary Heart Disease, and Stroke: A Comparative Analysis," American Journal of Public Health, Vol. 70, No. 12 (December 1980) (1975 societal costs); National Safety Council, Accident Facts, 1980, (1975 societal costs).

4. The FHWA has prepared a "technical report" consisting of a cost/benefit analysis that explicitly addresses the impact on deaths and injuries of several RRR approaches, which purports to support the FHWA's assertion that greater system-wide safety can be achieved through use of lower standards on more miles of improvements.

5. The FHWA's "technical report" is distorted and misleading; it is seriously flawed by basic errors in its use of accident data, its cost/benefit conclusions are incomplete, and its fundamental approach is irrelevant to the real-world policy decisions it purports to support.

6. The study by the FHWA Office of Highway Safety, "Safety Impact of Resurfacing Rural Roads," found that upgrading highways is more cost-beneficial in the long run than resurfacing. However, this conclusion was primarily based on a study by the Midwest Research Institute which did not specifically address this question and whose findings may not be directly applicable without further analysis.

7. The FHWA has not yet adequately analyzed the likely cost, safety, and durability implications of using different levels of design standards for RRR projects, although the Safety Board and others have called for such an analysis throughout the 5 years of rulemaking on the RRR program.

8. Although the Federal-aid RRR program began in 1976, the FHWA has failed to use the 5 years since then even to collect the data necessary for an analysis of the likely cost, safety, and durability implications of using different levels of design standards for RRR projects.

9. The FHWA has proposed in its current rulemaking to implement the RRR program by permitting each State to develop its own RRR standards and procedures. This approach was explicitly rejected by the FHWA in earlier rulemaking proposals because it would not produce "uniform, nationwide criteria" for the program, yet it has now been proposed again without explanation or justification.

10. The FHWA has proposed in its current rulemaking to permit the States to develop their own RRR criteria based on the American Association of State Highway and Transportation Officials (AASHTO) Geometric Design Guide for RRR of Highways and Streets. This document was explicitly rejected earlier by the FHWA because of its severe safety deficiencies, yet its use is now being supported by the FHWA without explanation or justification.

11. Five years after the Congress authorized the Federal-aid RRR program, the FHWA is no closer to being able to provide credible assurance to the Congress and the public that it can develop a balanced policy of construction, preservation, upgrading, and maintenance of the Federal-aid Highway System that will provide facilities predictably "conducive to safety, durability, and economy of maintenance."

RECOMMENDATIONS

The Safety Board believes that the Congress should consider amending the 1978 Surface Transportation Assistance Act to limit the amount of Federal-aid funds which may be obligated for RRR projects on the Federal-aid Primary, Secondary, and Urban Systems. The Congress should maintain this limit until the Federal Highway Administration completes the analyses recommended by the National Transportation Safety Board in this report that would document and analyze current RRR practices, would set forth

proper standards for RRR projects, would show the optimum combinations of Federal-aid construction/reconstruction and RRR projects, and would describe the impact of RRR practices on highway system condition and safety.

As a result of this evaluation, the National Transportation Safety Board recommended that the Secretary of Transportation:

> Direct the Federal Highway Administration to review and document, within 1 year, the current practices used in each State in conducting RRR projects. At a minimum, this review should include: documentation of the exceptions requested by each State to 23 CFR Part 625 design standards; the exceptions granted by each PHWA Division Administrator; the bases on which these exceptions are being granted; the procedures used to analyze the impact on cost and safety of the projects; and any results of those analyses. (Class II Priority Action) (H-81-88)
>
> Direct the Federal Highway Administration to develop a comprehensive, objective analysis that will carefully and fully describe the design criteria for individual RRR projects and the criteria by which the FHWA will approve State selection of RRR projects. (Class II, Priority Action) (H-81-89)
>
> Direct the FHWA to prepare an analysis that will show, within the overall Federal-aid Highway Program, the optimum combination of construction/reconstruction and RRR projects for assuring the preservation and enhancement of the Federal-aid Highway System. (Class II, Priority Action) (H-81-90)
>
> Direct the FHWA to develop and publish for comment, prior to issuance of a final RRR rule, a plan for monitoring and evaluating the impact of the RRR program on the Federal-aid Highway System condition and safety. (Class II, Priority Action) (H-81-91)
>
> Direct the FHWA to continue to administer the RRR program under existing procedures and standards for new construction projects, with exceptions permitted only if their basis and predicted impact are documented for review and future evaluation. (Class II, Priority Action) (H-81-92)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ PATRICIA A. GOLDMAN
Member

/s/ G. H. PATRICK BURSLEY
Member

FRANCIS H. McADAMS, Member, did not participate.

September 22, 1981

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